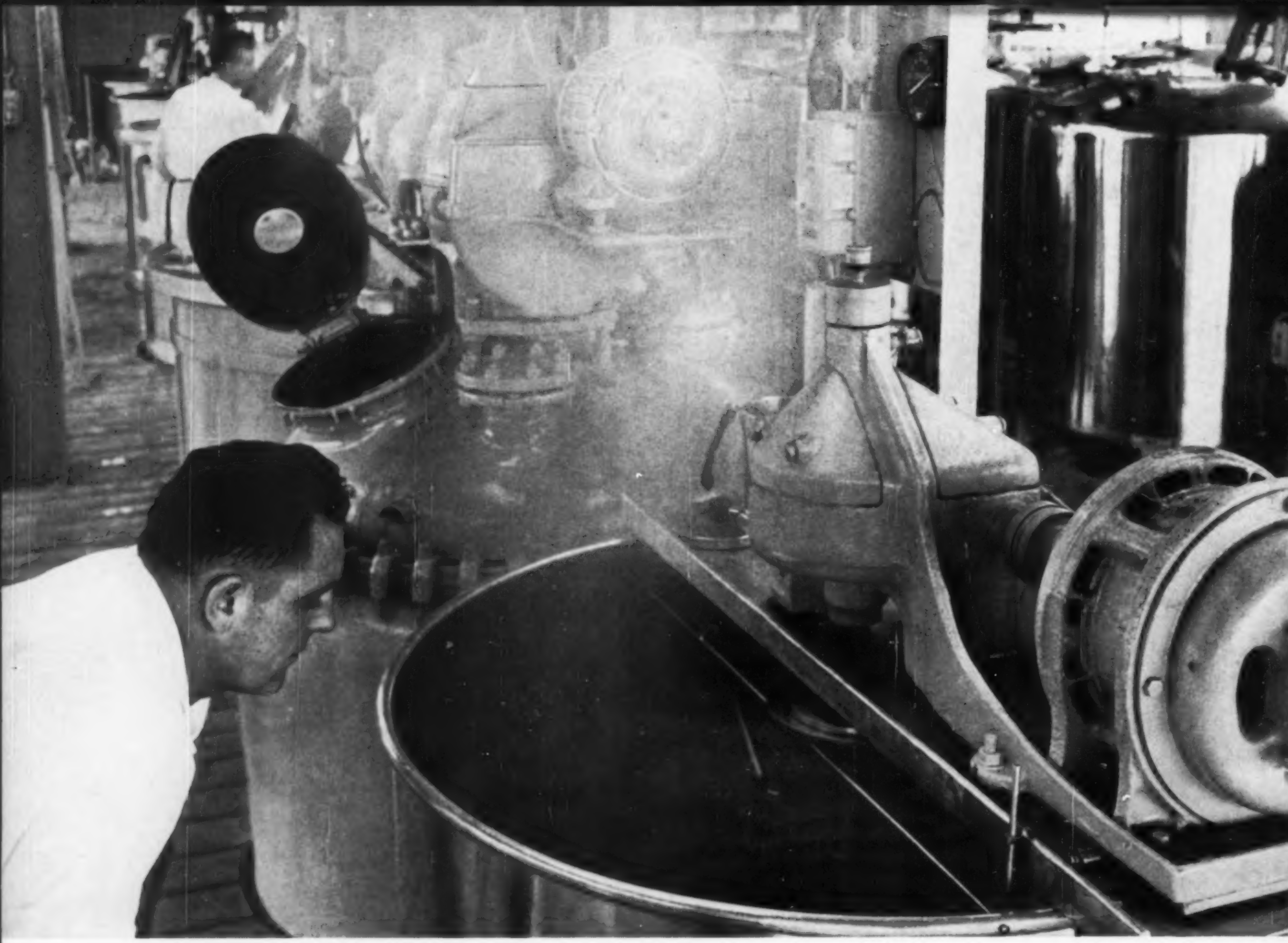
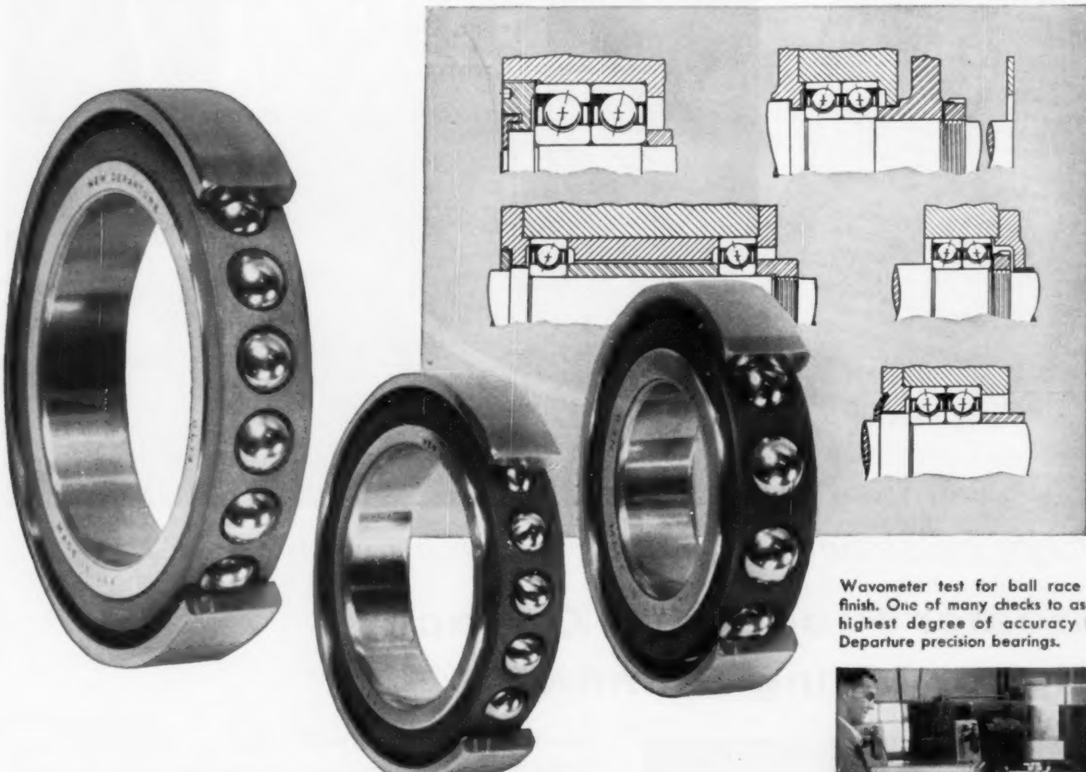
MECHANICAL ENGINEERING

October, 1958

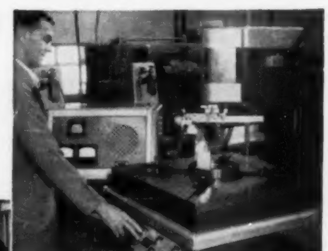
Atomic Reactor- Handle with Care



ND FACTS



Wavometer test for ball race surface finish. One of many checks to assure the highest degree of accuracy in New Departure precision bearings.



Checking bearing face flushness under axial loads.

FOR PRECISION LOCATION... PLUS WIDE ADAPTABILITY

NEW DEPARTURE BALL BEARINGS

New Departure angular contact ball bearings are available in a full range of Extra-Light, Light and Medium Series, to all precision specifications. They give the designer a wide variety of bore, outside diameter and width relationships and mounting methods.

Made to light, medium and heavy preloads, and ground for universal mounting in any of the duplex arrangements or separated by spacers of equal length, they assure exact location of shafts or spindles under load conditions of every kind.

For full information, send for free booklets BA and DD on design and application.

1908–1958 GM FORWARD FROM FIFTY

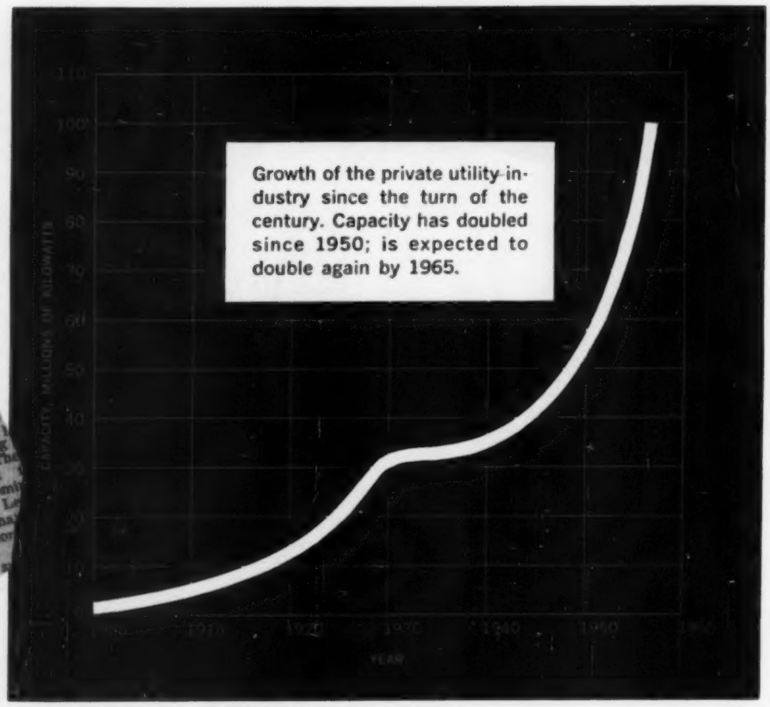
NEW DEPARTURE
DIVISION OF GENERAL MOTORS, BRISTOL, CONN.
NOTHING ROLLS LIKE A BALL

New York Herald Tribune, May 16, 1958

Kw. Capacity Hits 100 Million

A milestone in electricity generation has been reached with the installation of the 100,000,000th kilowatt of investor-owned capacity, it was reported yesterday by Edison Electric Institute.

On May 11, Tucson Gas, Electric Light & Power Co. crossed the threshold with installation of a 75,000-kilowatt generator. A record 15,750,000 kilowatts of new generating equipment is being installed this year by electric utilities, including government operations. The electric utility industry has doubled its installed capacity since 1950.



A major milestone in America's march toward

• Greater Productive Capacity
• Higher Living Standards

POWERED BY A C-E BOILER, this is the plant that brought the utility industry across the 100,000,000-kw threshold. It's the 75,000-kw Plant No. 4, Tucson Gas, Electric Light & Power Co., Tucson, Ariz. (Sanderson & Porter, Consulting Engineers)

Continuing their remarkable expansion of electrical generating capacity, America's investor-owned utility companies reached, in May, the significant landmark of 100,000,000 kilowatts. That's about double the capacity – privately and publicly owned – of any other country in the world.

Growth like this puts real meaning in the words "Live Better . . . Electrically." For example, it means the average American housewife today has the electrical equivalent of many servants helping her to do her housework . . . the average factory worker has the equivalent of 367 helpers. Thus, the utility industry, in its constant drive to provide *more power for more people,* has had perhaps the greatest single share of the job of assuring a steady rise in the standard of living in this country.

Combustion Engineering, too, has had a big part in this growth. In the past **ten years alone,** C-E Boiler installations have accounted for more than 25,000,000 kw of new capacity. Earlier C-E installations add many more millions of kilowatts to this figure. And, incidentally, the Tucson plant (left), which pushed the utility capacity over the 100,000,000-kw mark, is powered by a C-E Boiler.

As the utility industry heads toward its second hundred-million kilowatts, Combustion Engineering congratulates it for its vital role in making America ever more productive and prosperous.

C-E

COMBUSTION ENGINEERING

Combustion Engineering Building
200 Madison Avenue, New York 16, N. Y.

C-161

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

MECHANICAL ENGINEERING

PUBLISHED BY
THE AMERICAN SOCIETY OF
MECHANICAL ENGINEERS

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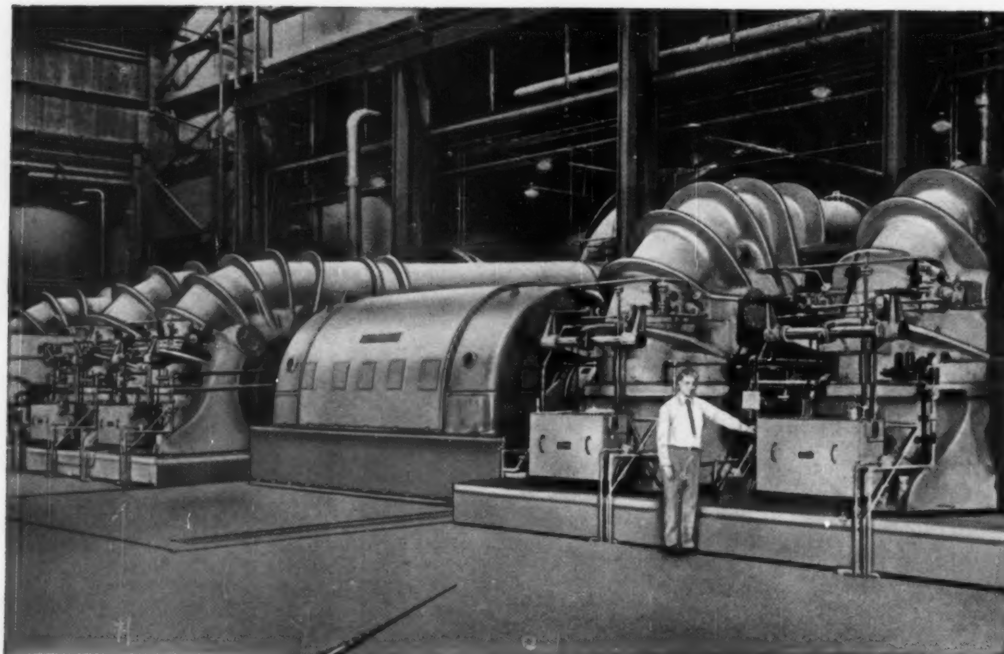

Roots-Connersville creates stop-and-go whirlwinds for aircraft research

Man-made air masses that match the violence of nature's hurricanes pour from the Roots-Connersville Blowers at the Lewis Flight Propulsion Laboratory of the National Advisory Committee for Aeronautics. Yet the power of these huge wind-making machines can be instantly controlled, from a soft, whispering breeze to a roaring, whirling cyclone. In the reverse, the siphoning air movement can develop almost perfect vacuums to simulate the air conditions of high altitudes. A similar but larger N.A.C.A. "wind-making system" has now been completed at Langley Field, Virginia.

The same engineering and manufacturing abilities that developed these stop-and-go whirlwinds are applied by Roots-Connersville to the everyday movement of gas and air, in small or large quantities, for industry. Now in its second century of service, Roots-Connersville Blower Division, one of the Dresser Industries, designs and builds the world's most extensive and varied line of such equipment.

Teamwork . . . that serves the world!

In its specialized field, each Dresser company, operating independently, has the experience, facilities and engineering manpower to meet the progressive needs of the industries it serves. Whenever an unusually challenging problem is put before any Dresser operating unit, the vast research, engineering and production facilities of all divisions of Dresser Industries, Inc. can be swiftly mobilized into effective teamwork. Throughout the oil, gas, chemical, electronic and other industries, this coordinated performance is known as the Dresser *Plus* ✚ . . . a standard of comparison the world over. *Briefacts* gives the complete story of the Dresser *Plus* ✚. Write for your copy today.

Tomorrow's progress planned today

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A plant built on the philosophy of "don't accept anything at face value"...

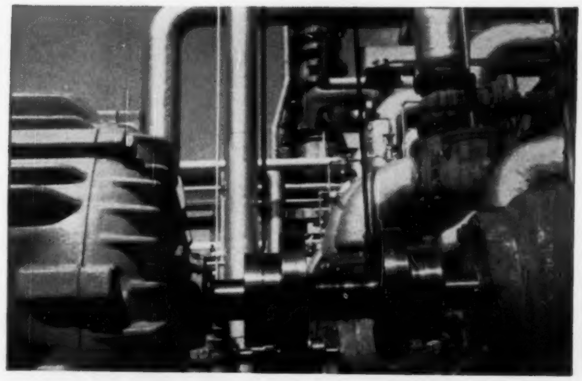
Tidewater's "Refinery of the Future" Uses 471 Fast's Couplings to Reduce Maintenance

IN PLANNING Tidewater's Delaware Refinery, all equipment purchases were examined from every angle . . . capital investment, manpower, maintenance and reliability. Fast's Self-Aligning Couplings were used throughout because they met Tidewater's exacting demands.

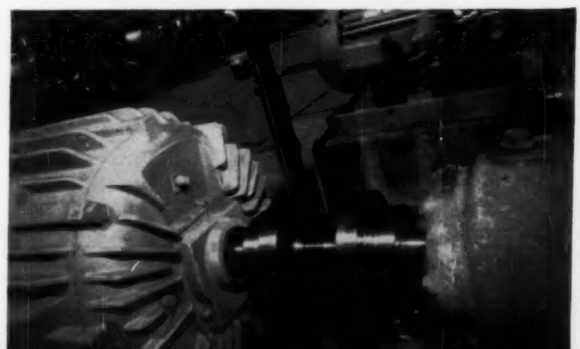
Tidewater's equipment design policies were established by survey teams that visited refineries all over the country. They carefully appraised each plant and asked operators what improvements they would make and what features they would retain if they were to redesign their drives.

In 471 applications at this refinery, Fast's Couplings guarantee mechanical flexibility that eliminates costly shutdowns and expensive shaft replacements. Fast's have the reputation of frequently outlasting the equipment they connect. This means savings in maintenance and down-time . . . in addition to protecting costly equipment against errors of alignment.

Nearly 40 years of coupling experience qualifies Koppers to solve *your* coupling problem. Write today for full details to: KOPPERS COMPANY, INC., Fast's Coupling Dept., 3408 Scott Street, Baltimore 3, Md.



Fast's Couplings give dependable, trouble-free service throughout Tidewater's entire production facilities.



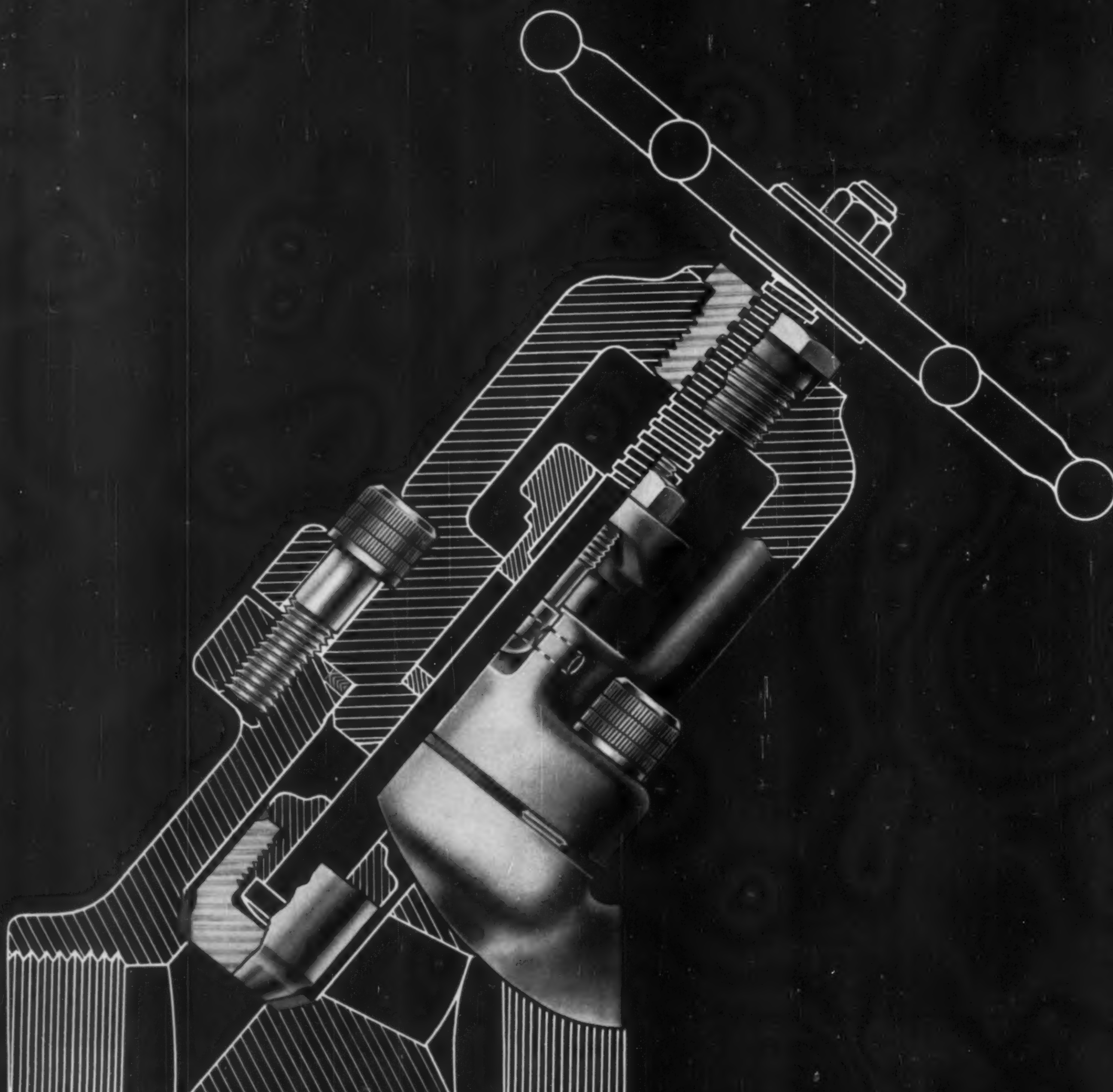
This Fast's Coupling drives a pump delivering heavy naptha to the Solutizing plant.

Engineered Products Sold with *Service*

KOPPERS

THE ORIGINAL

FAST'S Couplings



EDWARD "848" SERIES GLOBE VALVE
(ANGLE TYPE ALSO AVAILABLE)

What's New from Edward Valves

New Products . . . Problems and Solutions. . . Information on Steel Valves from Edward, Long-Time Leader in the Field!

Major Improvements at No Extra Cost Mark New "848" Series Forged Steel Stop Valves

In an industry where any change in design is "news," Edward is proud to introduce a new line of 600-lb forged steel stop valves with so many major design improvements *at no increase in cost.* These Rockwell-built Edward valves are suitable for air, water, oil and other hydrocarbons, anhydrous ammonia and other gases, steam and other non-corrosive fluids.

NEW MATERIALS USED THROUGHOUT

Besides tough drop-forged steel, which is the basis of these valves, Edward introduces such innovations as stainless steel gland bolts, an aluminum-bronze yoke bushing, solid disk of chromium-cobalt-tungsten stainless steel, spiral wound gasket of stainless steel and asbestos, and special alloy cap screws linking body and bonnet.

NEW IMPROVED BODY-BONNET JOINT

Four molybdenum alloy cap screws secure bonnet to valve body. These compact, high-strength cap screws require less space than ordinary nuts and bolts, can be handled with one hand, and deliver maximum compressive force with minimum tightening torque. A new spiral wound gasket, consisting of some 20 turns of stainless steel and asbestos, provides controlled compression not possible with ordinary flat gaskets. Because this spiral wound gasket is free to expand and contract as needed, it "takes up the slack," maintains a leak-proof seal between body and bonnet.

NEW SOLID DISK OF SPECIAL ALLOY

Disk is made of chromium-cobalt-tungsten stainless steel. This new alloy has added resistance to erosion, holds its hardness better under high temperatures than other disk materials. Disk is lock-welded to disk-nut, eliminating wobble and chatter—especially important when valve is called upon for throttling duty.

INTEGRAL STELLITE SEAT FOR LONG LIFE

Valve seat is Stellite—a harder, longer-wearing material with excellent resistance to corrosion, erosion and temperature. Seat is integrally welded to body.

"848" SERIES ROCKWELL-BUILT EDWARD VALVES are available in ¼", ⅜", ½", ¾" and 1" sizes. They are rated at 600 psi—at 910F in carbon steel and at 1030F in chrome-molybdenum steel. Globe or angle types, with screwed or welding ends. Write for facts on performance . . . price . . . and delivery. Address *Edward Valves, Inc., 1200 West 145th Street, East Chicago, Indiana.* (Subsidiary of Rockwell Manufacturing Company.) Represented in Canada by Lytle Engineering Specialties, Ltd., 360 Notre Dame St. W., Montreal 1, Quebec.

EDWARD STEEL VALVES

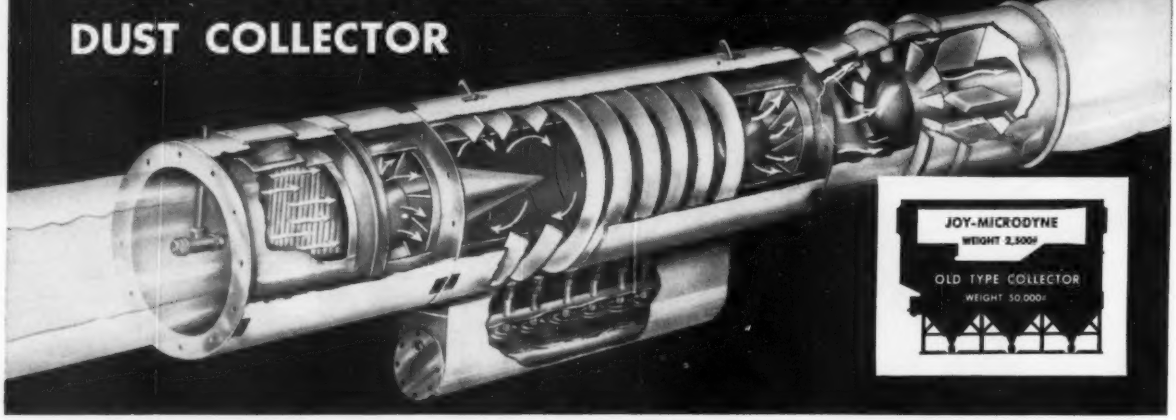
another fine product by

ROCKWELL

Catalog 14 contains full data on the complete Edward line of forged and cast steel valves from ¼" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, instrument, gage and special designs; for pressure up to 10,000 lbs; with pressure-seal, bolted, union or welded bonnets, with screwed, welding or flanged ends.

~~NEW~~ PROVED JOY-MICRODYNE

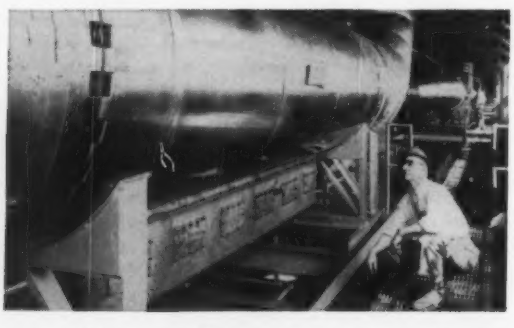
DUST COLLECTOR



Profile of a Problem Solver

Here is an in-duct "educated pipe" that laughs at space, weight and water limitations as it collects over 99% of dust 5 microns and larger; 92% of 2-micron dust, and substantial amounts of smaller dust.

Particles enter through water-saturated air, slam against a water-film-covered impingement element, encase themselves in water droplets as they pass through, then whirl and collect on the sides of the middle section, to finally drain into a sump. Cleaned air is straightened and thrust on its way by an integral Joy Axivane Fan.



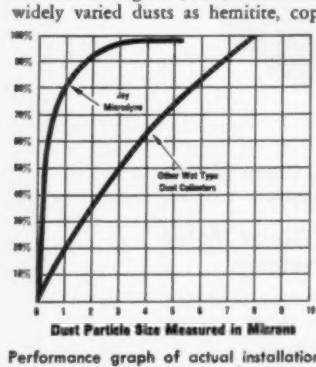
This 48,000 cfm installation shows compact assembly and space economy of in-duct placement.

SAVES SPACE—Installs as an integral section of duct-work; requires only 1/10 to 1/20 the space of conventional units. 2500 cfm unit is 10 feet long; 1.5 feet in diameter.

SAVES WEIGHT—Even the largest unit—64,000 cfm, 5 feet in diameter, 32 feet long—weighs only 6,500 pounds . . or 1/5 the weight of conventional collectors. 2,500 cfm unit weighs only 325 pounds.

SAVES WATER—The largest Joy collector requires only 48 GPM flow—much less than comparable wet collectors. Add a Delpark Filter (Sold by Joy) and water can be recirculated to recover valuable dusts. The filter also reduces water borne solids to give a dependable, clear water supply from a dirty water source.

SUCCESSFUL INSTALLATIONS—Joy collectors from 500 cfm through 64,000 cfm are *now in use* collecting such widely varied dusts as hemitite, copper and uranium ores, coal, quartz, limestone, phosphate, stainless steel and titanium carbide grindings. For answer to your dust collecting problems, write, wire or call: ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** *In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

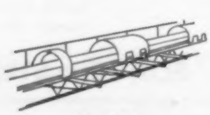


Performance graph of actual installation shows efficiency of the Joy-Microdyne Dust Collector. (A micron is 1/25,000 inch)

WSW 1 7002-231

JOY . . . EQUIPMENT FOR INDUSTRIAL PLANTS . . . FOR ALL INDUSTRY

WRITE FOR FREE BULLETIN 231-80B



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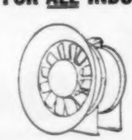
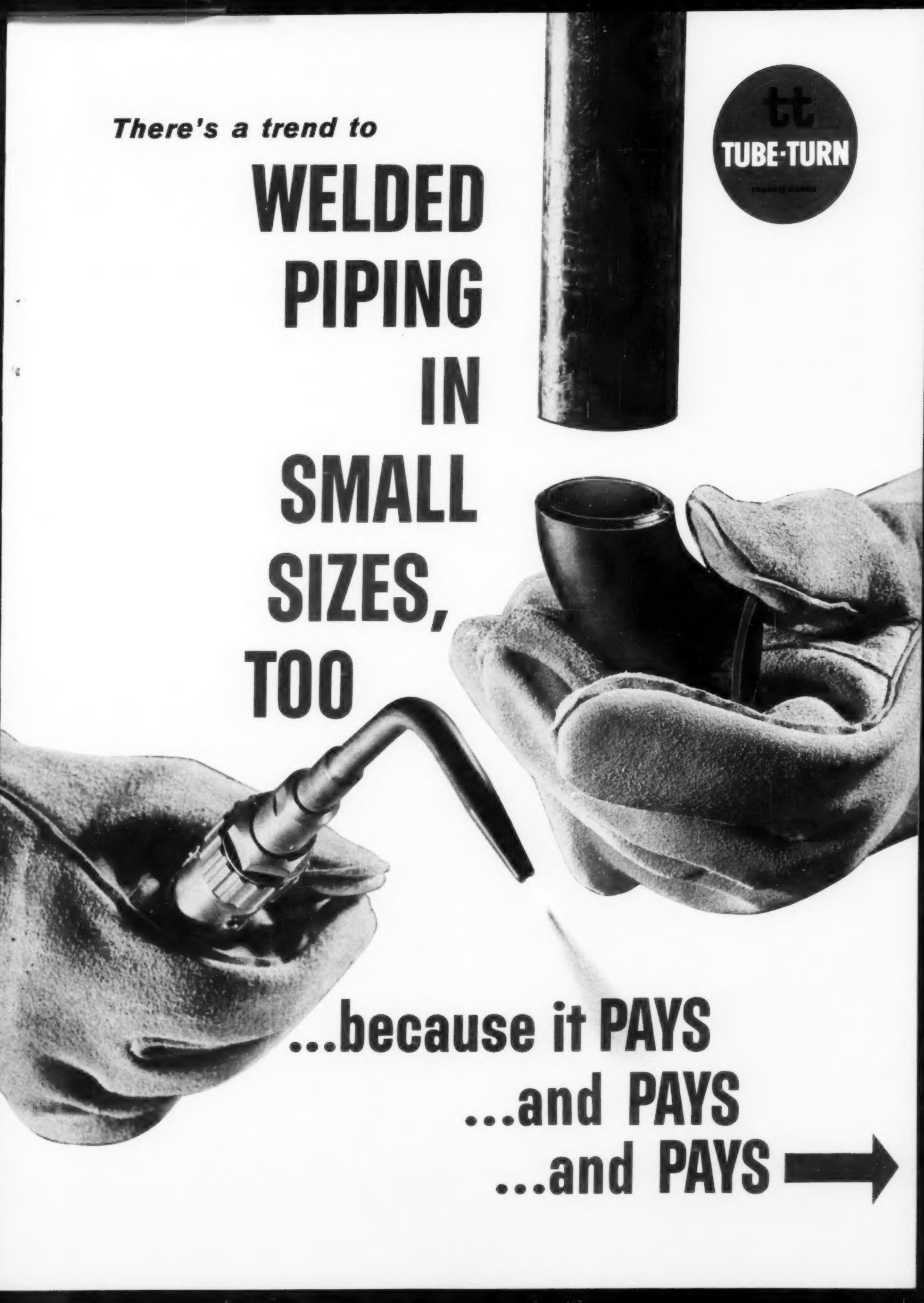


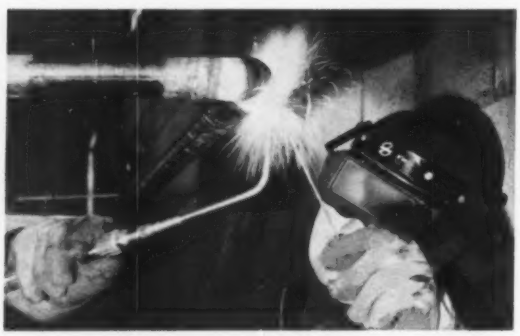
Fans and Blowers


There's a trend to
WELDED PIPING IN SMALL SIZES, TOO
...because it PAYS
...and PAYS
...and PAYS
tt
TUBE-TURN

In small sizes . . . all sizes . . .

welded piping with TUBE-TURN® FITTINGS pays off 3 ways!

SAVES ON MATERIAL. Schedule 40 pipe, butt welded, is stronger in bending and fatigue and has greater thickness for corrosion resistance than Schedule 80, threaded. Hence, welding piping can be lighter . . . can cut material costs 30-50%.



SAVES ON INSTALLATION. Butt welded joints in 1½" piping, such as school heating line shown, averages 7 minutes compared to 8 minutes for threading and tightening fitting. Tools are simple, inexpensive.

MORE INFORMATION—"The Economics of Welding Small, Non-critical Pipe" gives helpful information. Mail the coupon for your free copy.

TUBE TURNS
224 East Broadway, Louisville 1, Kentucky

Please send free copy of "Economics of Welding Small, Non-critical Pipe."

Company Name ______________________

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City ____________ *Zone* ____ *State* ________

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SAVES ON MAINTENANCE. Butt welded joints are permanently as strong and leakproof as the pipe itself. Photo shows ½" welded water-heat piping for shopping center . . . specified to eliminate maintenance expense.

TUBE-TURN* Fittings and Flanges in sizes from ½" to 42" . . . in all types and materials . . . are available promptly from your nearby Tube Turns' Distributor. All your needs on one order cuts your purchasing red tape.

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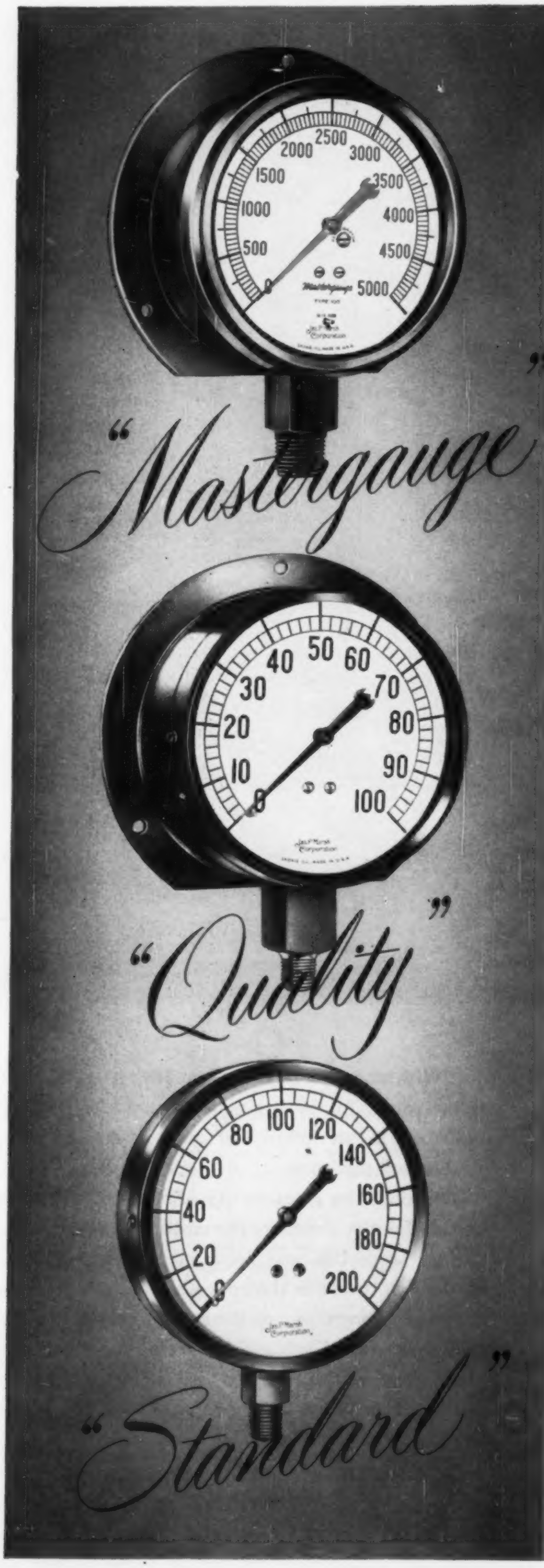

What pressure gauge for your particular need?

The clear-cut economical answer to your specific gauge problem is right here in the Marsh line. It is here because the Marsh line contains the world's most complete range of gauges in the three broad brackets of gauge applications.

THE "MASTERGAUGE" GROUP...for those extreme services that demand the ultimate in gauge precision, accuracy and stamina.

THE "QUALITY" GROUP...also for tough conditions, but less severe than the conditions served by the "Mastergauge" Group.

THE "STANDARD" GROUP...for the general run of pressure gauge services.

While these three brackets run a wide gamut of prices, the difference between them is not so much a matter of *grade* as a matter of *kind* and *purpose*. All gauges in all groups reflect Marsh precision and quality. Collectively they cover practically every conceivable gauge requirement.

The answer is in the catalog...but if you have a special problem let our engineering department work with you to select the most efficient, most economical solution to your problem.

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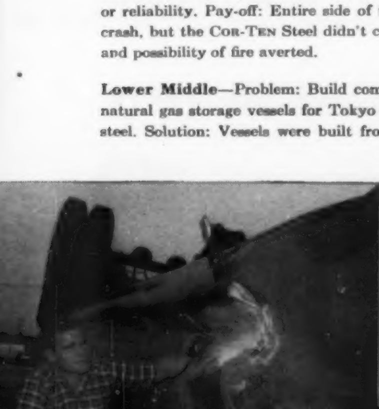
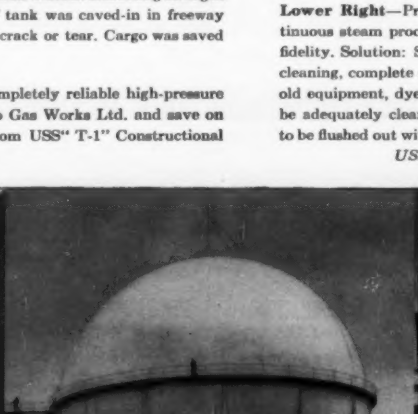
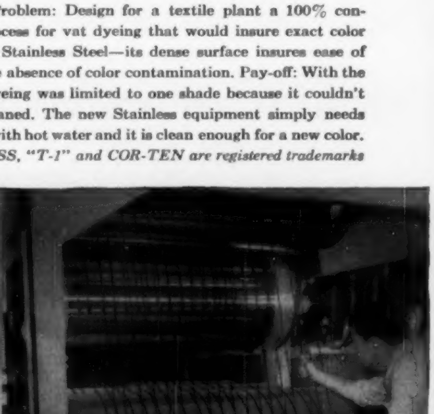
MARSH

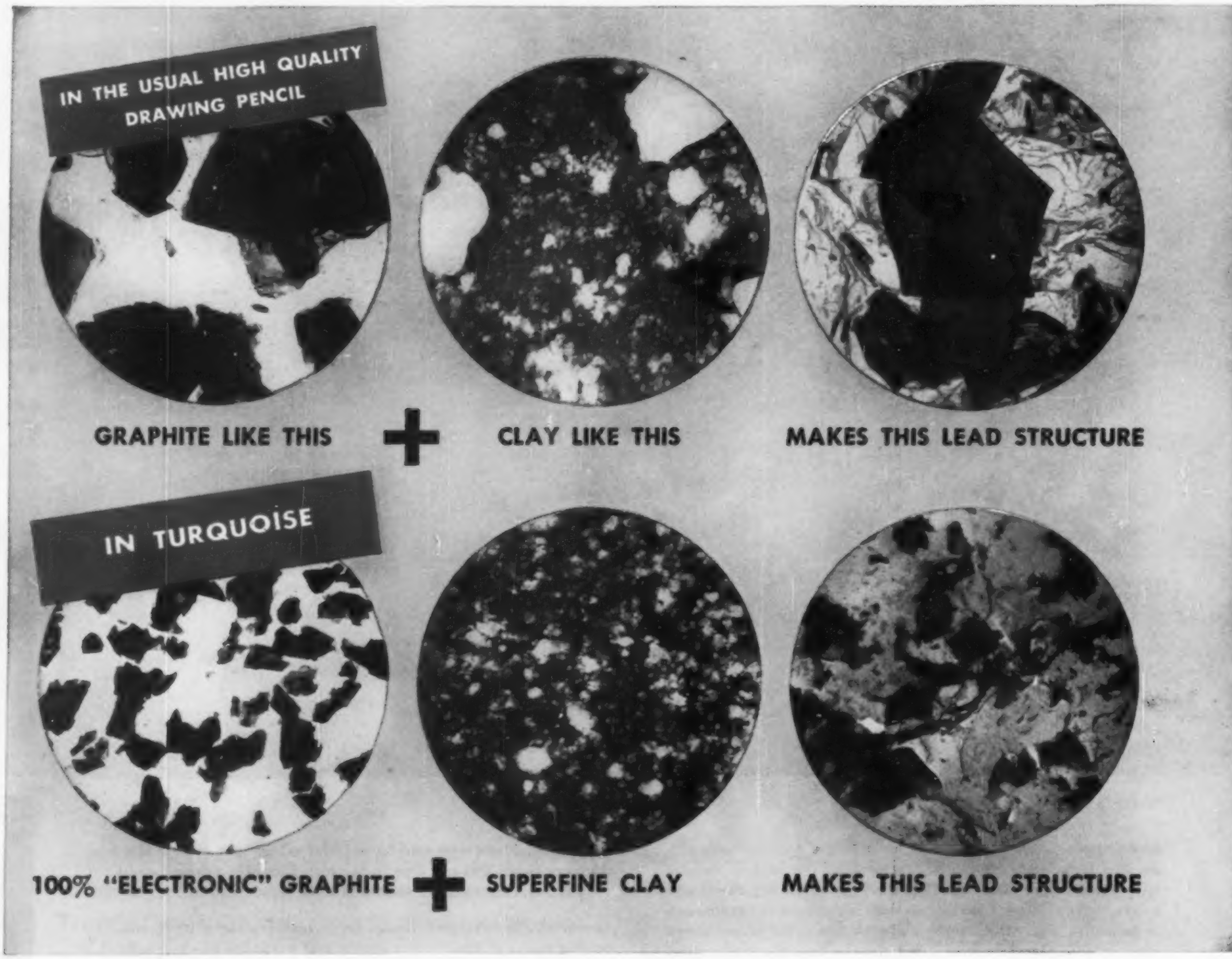
"THE STANDARD OF ACCURACY"







Now you can see why only leads & pencils give you perfect



YOU ALWAYS GET PROVEN QUALITY FROM TURQUOISE DRAWING LEADS AND PENCILS

PROVEN GRADING - 17 different formulae make sure you get exactly the line you expect—from every pencil, every time.

PROVEN DURABILITY — Because compact lead structure gives off no chunks of useless "dust" to blow away, Turquoise wears down more slowly.

PROVEN NEEDLE-POINT STRENGTH — as electron photomicrograph shows, Turquoise lead structure is finer—and therefore stronger. It holds a needle point under drawing pressures for long lines of unchanging width.

EAGLE PENCIL COMPANY • NEW YORK • LONDON • TORONTO • MEXICO • SYDNEY • BOGOTA

Traditionally dependable

TAYLOR

The Taylor Forge line of Welding Fittings is truly complete, embracing every size, type, thickness and material for any service condition.

Because extreme dimensional accuracy of the assembled union is required in order to assure precise metering, Taylor Forge Orifice Flange Unions are specified for this exacting service by the larger users throughout the world.

Forged and fabricated booster nozzle assembly for guided missile. Both hammer and press forging methods are used in producing this part.

Spiral-Weld Pipe, our original product, (first made as spiral riveted pipe nearly 60 years ago), remains to this day a major item and its use continues to expand. Its money-saving features are widely recognized in many services.

Electric Fusion Welded Pipe is made in sizes from 14" OD to 96" OD with wall thicknesses to 1.531", and in a variety of materials, including stainless and alloy steels.

in many different fields

FORGE

Welding Fittings and Forged Flanges

FORGED, ROLLED AND EXTRUDED PRODUCTS IN CARBON AND ALLOY STEELS, STAINLESS STEEL and all other ferrous and non-ferrous metals

Wherever piping is important—as in power, processing, gas transmission and distribution, heating, air conditioning and many other fields—Taylor Forge is recognized as the leading manufacturer of highest quality *Welding Fittings* and *Forged Flanges* of every size, type and wall thickness or pressure standard.

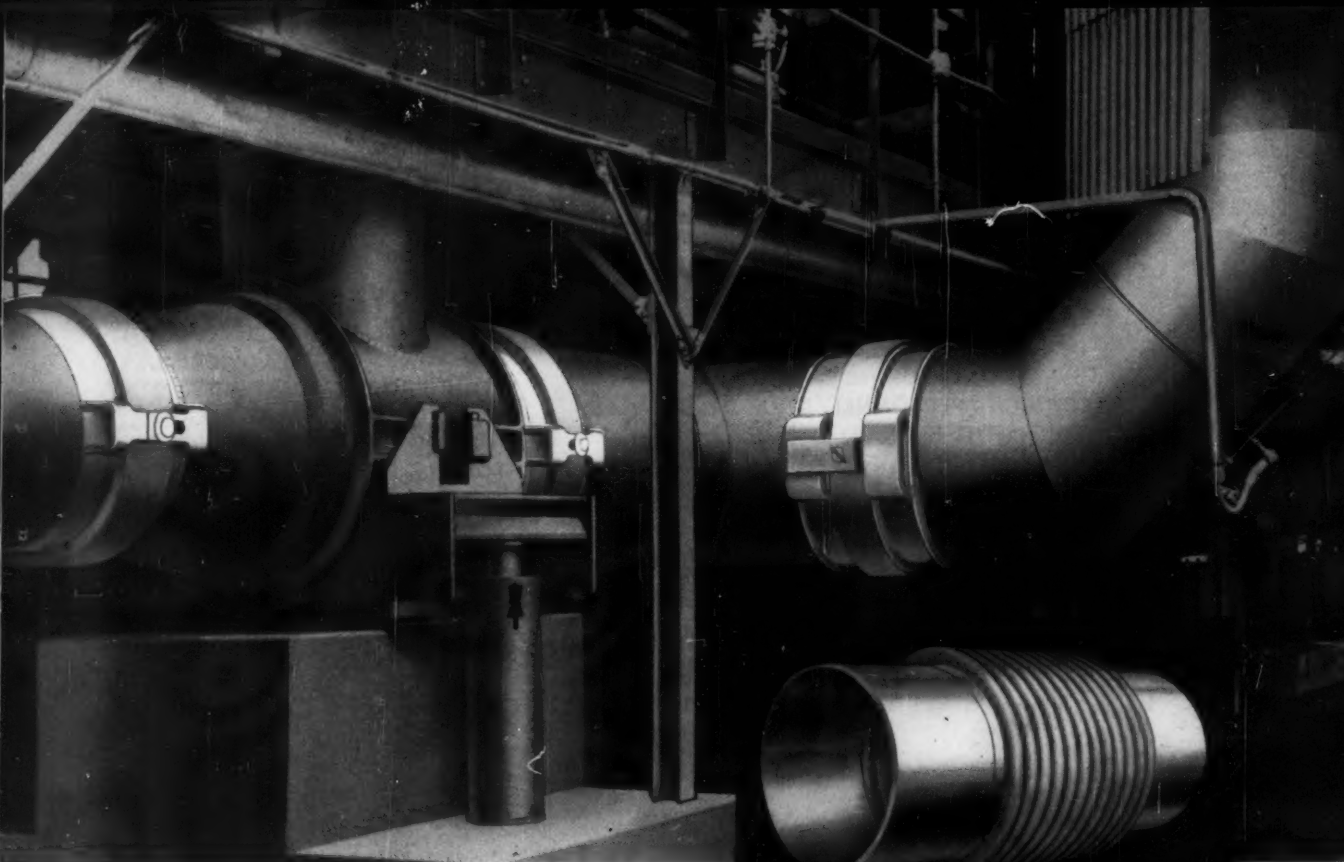
Many other types of forged, rolled and extruded products help make Taylor Forge depended upon in many different fields throughout industry. One thing all have in common is the dependability, the integrity that has always been associated with the name TAYLOR FORGE.

Taylor Forge & Pipe Works

General Offices and Works: P.O. Box 485, Chicago 90, Illinois
Plants at: Carnegie, Pa.; Somerville, New Jersey; Gary, Indiana; Houston, Texas; Fontana, Calif.; Hamilton, Ont., Canada
District Sales Offices: New York, Boston, Philadelphia, Pittsburgh, Atlanta, Chicago, Houston, Tulsa, Los Angeles, San Francisco, Seattle, Toronto, Calgary, Montreal.

Taylor Forge was America's first and is still the country's foremost manufacturer of Welding Necks, Nozzles, Large Diameter Flanges and similar boiler, heat exchanger and other pressure vessel components. Such parts are made in any size and material for any service condition.

This Gas Pipeline Combination Valve Setting and River Crossing Header with integral venturi reduction is typical of the many different forged headers with contoured outlets produced by Taylor Forge for the petroleum processing and gas transmission industries.



View of hydrocarbon outlet line just below reactors shows three of a total of 67 Badger S-R Expansion Joints at Firestone's new Butadiene Plant at Orange, Texas. Joints shown are equipped with guide bars and external covers.

Series 50W S-R Expansion Joint
Shown with cover removed

Badger S-R Expansion Joints handle rugged 1100° service at Firestone's new plant

The Houdry process used at Firestone Tire and Rubber Company's new Butadiene Plant calls for temperatures up to 1100°. Add critical forces on anchors and connected equipment, wind loading, and complex piping arrangements and you have real problems in piping and expansion joint design.

Working together with Catalytic Construction Co. and Firestone, Badger solved these problems with new Service-Rated (S-R) Expansion Joints. In all, sixty-seven joints have been installed, all of the new Series 50 (low pressure) S-R design. Ranging in size from 30″ to 72″, the joints are arranged singly or in systems of hinged and tandem types to absorb and control pipe line movement (which, due to the piping arrangement, is often axial and lateral — in *two different directions*). Stainless steel bellows are used in all joints; welding nipples are stainless or carbon steel depending on temperatures to be encountered.

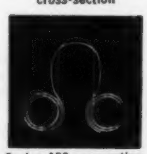
Here is another example of a severe pipe expansion problem Badger S-R Expansion Joints and engineering experience have solved successfully. Find out more about the ways they can help you — write today for illustrated brochure.

New corrugation and ring designs produce better equalization, "all-curve" flexing

Curvilinear Corrugations used in S-R Expansion Joints were developed by the Badger Research Department. Under operating pressures (white line) the new design produces more uniform movement per corrugation and natural "all-curve" flexing. Stress is reduced . . . life increased.

Series 50 corrugation cross-section

S-R Joints for higher pressures have tubular Reinforcing Rings. These new rings make metal-to-metal contact only in the "valley" of each corrugation allowing natural "all-curve" flexing (white line). Tubular shape permits greater effective flexing height which contributes to longer life.



Series 150 corrugation and ring cross-section

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S-R

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EXPANSION JOINTS

BADGER MANUFACTURING COMPANY

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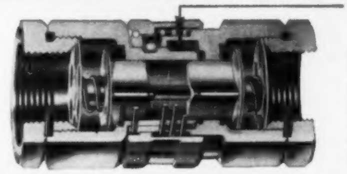
SNAP-TITE "H" COUPLING.......FOR HIGH PRESSURE APPLICATIONS

FOR HYDRAULIC OR AIR

"H" Coupling for high strength, higher efficiency, high-resistance to heavy line surge.
Sizes: 1/8" thru 10". Bulletin No. 240

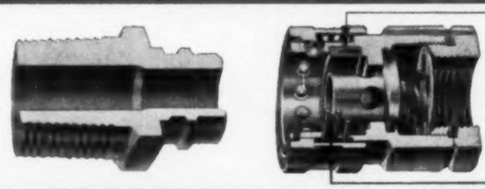


Exclusive U-packer gives a positive seal without compression set because of rubber distortion. Line pressure inside the U-packer keeps it open and forced against its metal backing—the higher the pressure, the tighter the seal.

SNAP-TITE 'IH' COUPLING.......FOR IMPACT IN AIR LINES

FOR RESISTING THE IMPACT OF RECIPROCATING AIR OPERATED TOOLS

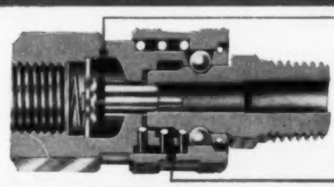
The 'IH' Coupling delivers more air to tools. Cylinder-type 'IH' valve for 360° contact.
Sizes 1/8" thru 1/2". Bulletin No. 248.



SNAP-TITE HI-FLOW COUPLING...FOR LOW PRESSURE APPLICATIONS

FOR AIR AND FLUIDS UP TO 150 p.s.i.

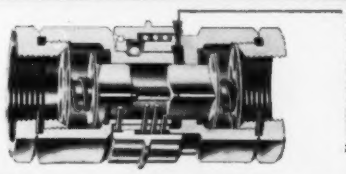
Hi-Flow is recommended to connect small air tools to plant air system, and for low pressure fluid transfer in small lines.
Sizes: 1/8" thru 3/8" Bulletin No. 249



SNAP-TITE "E" COUPLING.......FOR VACUUM and VERY LOW PRESSURE

FOR VACUUM SYSTEMS IN THE MICRON RANGE

"E" Coupling performs in the *micron* range in the smaller sizes both connected and disconnected. Recommended, too, for gravity flow . . . U.L. approved for LP Gas.
Sizes: 1/8" thru 10". Bulletin No. 250

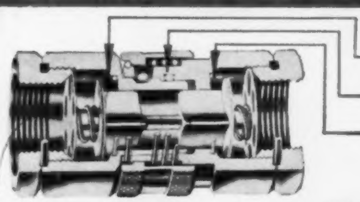


Nipple seals in coupler by depressing the lip of the E packer and slightly compressing the body of the packer. This new E-packer gives positive seal under high-pressure, low-pressure, and vacuum.

SNAP-TITE 'T' COUPLING.......FOR HARD TO HANDLE FLUIDS

FOR FUMING ACIDS, ALKALIES, SOLVENTS . . .

'T' is the only coupling now on the market for fluid temperatures from −40°F to +400°F. Its seals are made of Teflon for which there is no known solvent.
Sizes: 1/2" thru 3". Bulletin No. 270.

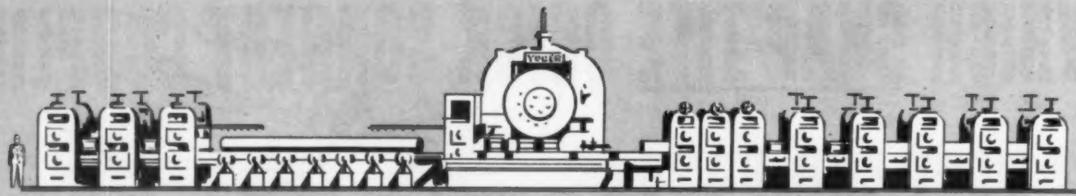


Snap-Tite Couplings are available plain, (without valves), and with either single or double shut-off. Couplings normally furnished in alloy steel, but all (except hi-flow) are also available in brass, aluminum, or stainless steel with a variety of finishes.

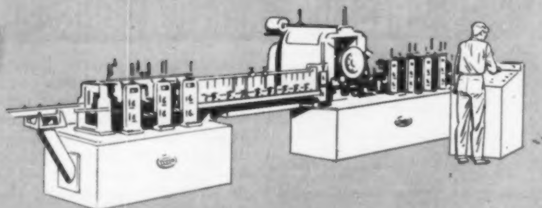
SNAP-TITE, INC., UNION CITY 4, PA.

★ Snap-Tite

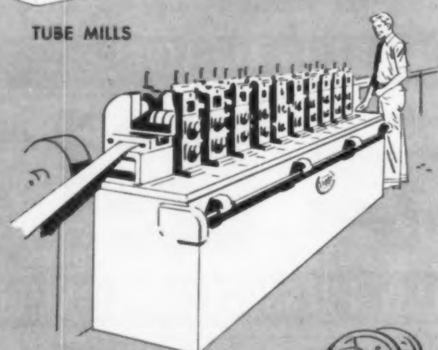
SNAP-TITE COUPLINGS CAN HANDLE ALMOST ANYTHING THAT FLOWS



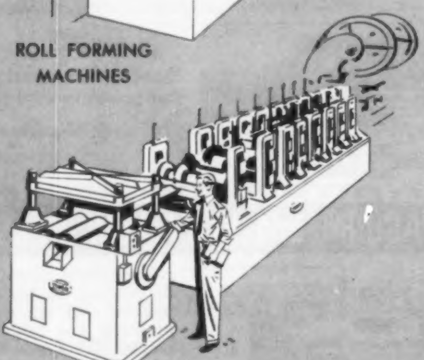
PIPE MILLS



TUBE MILLS



ROLL FORMING MACHINES



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Special attachments and auxiliary units can perform additional operations such as welding, coiling, punching or embossing without extra labor cost while increasing production speed.

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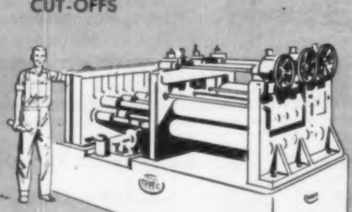
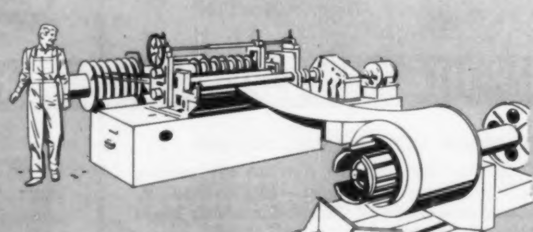


LEVELLERS



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ENGINEERING **YODER** MANUFACTURING

PIPE AND TUBE MILLS (ferrous or non-ferrous)

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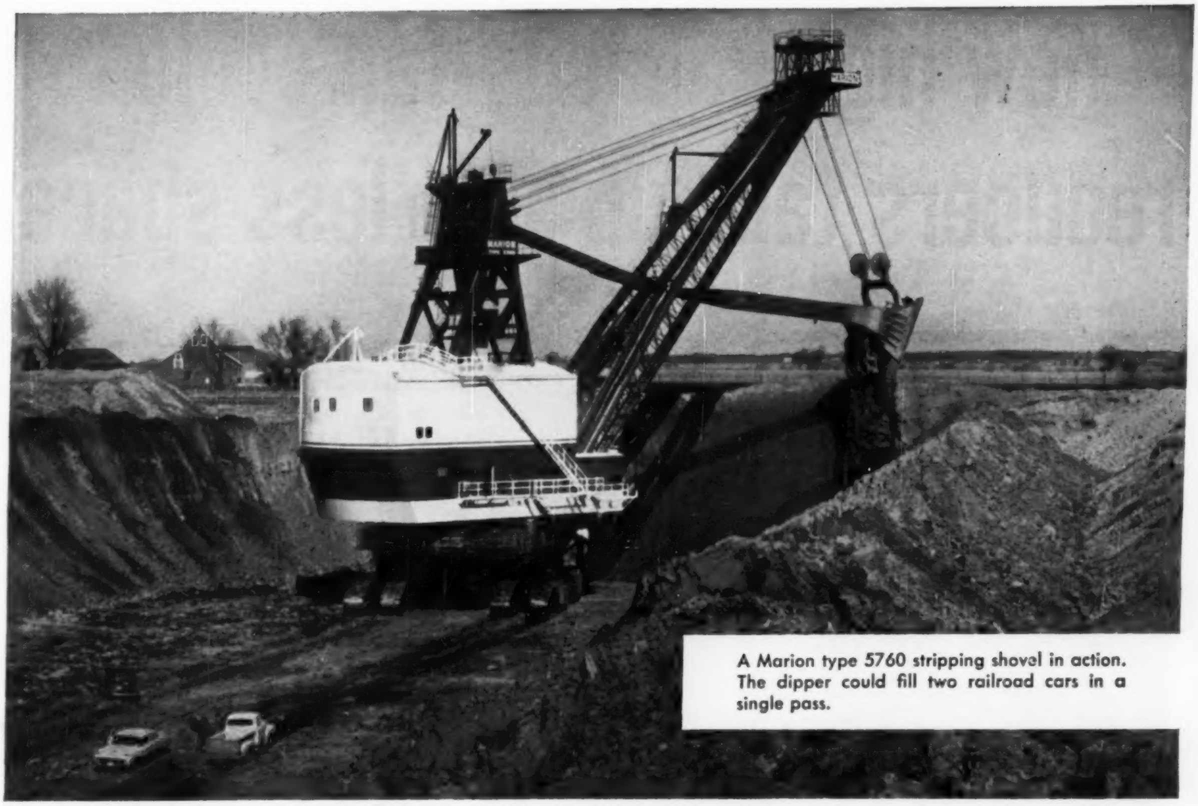
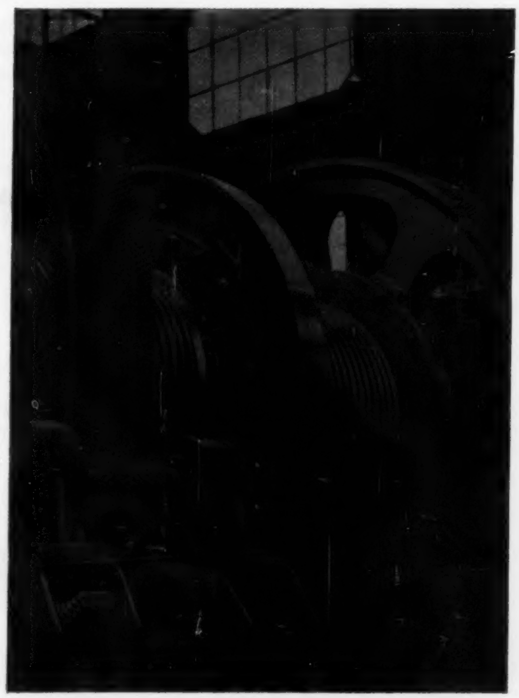


A Marion type 5760 stripping shovel in action. The dipper could fill two railroad cars in a single pass.

Farrel® gears take loads in stride on world's largest power shovels



Precision generation, combined with the use of highest-grade materials, give Farrel gears the ability to withstand the heaviest shock loads encountered in machine applications. The *backbone* in the gears—formed by the meeting of the two helices without a center groove—puts the entire face width of the gear to work. This pays off in extra strength and greater load-carrying capacity.

These are a few of the reasons why Farrel gears are "naturals" for the main-hoist drive in the largest power shovels ever built. Made by Marion Power Shovel Company, these giant machines have dipper capacities as high as 75 cubic yards.

Farrel engineers are available for help in working out unusual gear problems. Write today for further information.

FARREL-BIRMINGHAM COMPANY, INC.
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Plants: Ansonia and Derby, Conn., Buffalo and Rochester, N. Y.
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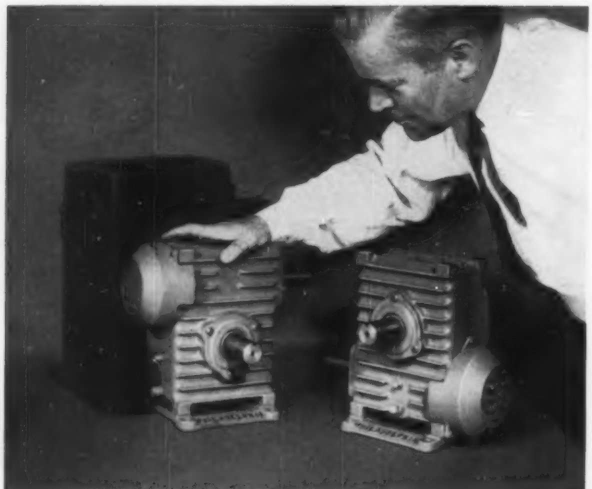
Farrel-Birmingham®

FB-1150

new high capacity fan cooled reducers take up 50% less space



LOOK AT THE SPACE YOU SAVE!

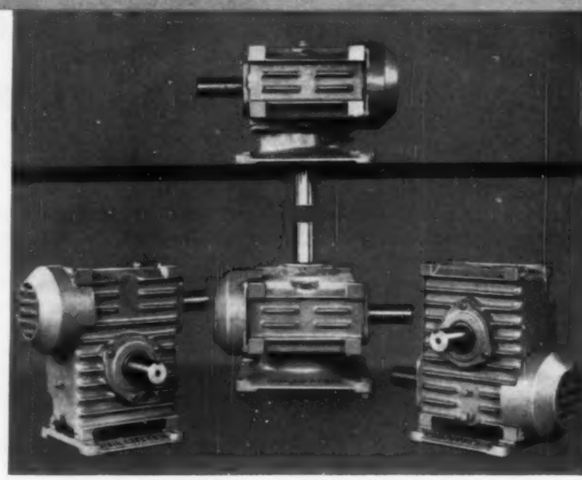
Think what this can mean to your products! You can make important savings in space and weight . . . in the neighborhood of 50% . . . depending upon output torque requirements. Or, you can design for heavier loads . . . up to 80% . . . without adding an ounce of weight to your product. You get more horsepower per dollar!

This new line of Philadelphia Fan cooled Worm Gear Reducers is available in 3, 3½ and 4″ center distances for ratios from 5 1/6:1 to 60:1. Fan cooling, sturdy finned housings, improved tooth forms, precision ground alloy steel worms and special high strength bronze gears all combine to give you a drive that will handle heavier loads in less space.

STANDARD STOCK PARTS SIMPLIFY SELECTION.

These new fan cooled units have a degree of simplicity and flexibility never before available. Standardized housings, fans, gearing and mounting bases permit you to select any drive arrangement you need . . . permit us to give you prompt delivery from stock.

They simplify your design problems too. For Example: horizontal units can be furnished without mounting bases. Housings can be designed as an integral part of your product.



For more information . . . horsepower ratings . . . dimensions . . . construction details . . . write for your copy of Bulletin WG-583.

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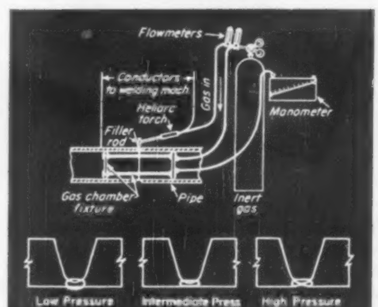
KELLOGG'S K-WELD® TECHNIQUE KEEPS PACE

During shop fabrication, *ninety* K-Welds . . . Kellogg's inert gas shielded technique of manual arc welding . . . were made by Kellogg on the Type 316 stainless main steam piping for Philadelphia Electric Company's Eddystone Station, Unit No. 1. All were heat treated after welding, at 1900-1950 F.

In the photo above, the K-Weld root bead already has been deposited —using 1/16 in. filler wire (16 Cr.-8 Ni.-2 Mo.). The operator is making the second pass by conventional manual arc welding. This and the remaining passes are made using covered electrodes (B&W 16-8-2) for this extremely heavy-walled section.

Inspections by liquid penetrant and radiography . . . *four for each weld* . . . were as follows: (1) After the first ⅝ in.; (2) Halfway between ⅝ in. and outer surface, provided the distance was greater than ¾ in.; (3) On completion of weld; (4) After solution heat treatment. These inspections show the extent to which Kellogg goes, beyond code requirements in this case, to control quality of fabrication.

The M. W. Kellogg Company welcomes inquiries on its complete service to the power piping industry from consulting engineers, engineers of power generating companies, and manufacturers of boilers, turbines, and allied equipment.



K-Weld root bead is deposited while pipe interior is under controlled inert gas pressure in specially designed portable gas chamber fixture. Diagram shows details of fixture, and how interior weld surface can be controlled by varying pressure.

Fabricated Products Sales Division

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KELLOGG

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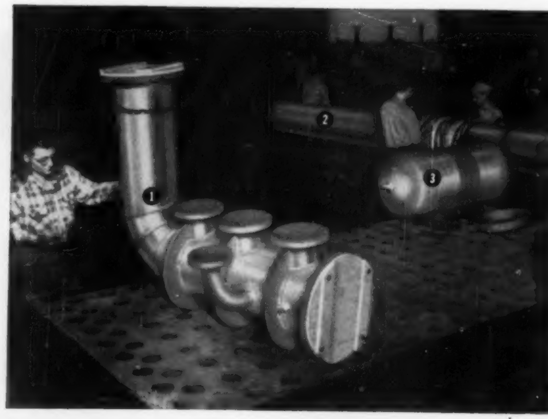
ALL IN A DAY'S WORK at *Pittsburgh Piping*



These three jobs are typical of the wide variety of custom piping work which we do for the power and process industries. In the background of the photo welders are shown making the heli-arc root pass on 18" O.D., 3.875" wall, chrome-moly main steam piping. In the foreground, ready for final inspection, is a 12" header for a process operation, fabricated of ⅜" aluminum alloy. The pressure vessel, of austenitic steel, is one of many we produce for atomic energy application. The manufacturing of this type of piping requires specialized facilities . . . for engineering, fabricating, testing, assembly, and erection. We have those facilities. Use them on your piping jobs.

Promoting Progress ***IN POWER AND PROCESS PIPING***

Pittsburgh Piping **AND EQUIPMENT COMPANY**
158 49th Street—Pittsburgh, Pa.

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Chicago . . . . . . Peoples Gas Building **New Orleans . . . . P. O. Box 74**
New York . . . . Woolworth Building

PP-31

rigid specifications

Tension tests are required to be made at room temperatures and at 670° F. The following minimum physical properties shall be met:

At Room Temperature:

TS	YS	EL	RA	CHARPY V-NOTCH
70,000	30,000	45	50	50

At 670° F. the minimum tensile strength shall be 51,000 p.s.i. and the minimum yield strength 18,300 p.s.i.

Rejection

Each casting that develops unacceptable defects during shop working or fails to conform to all of the requirements of these specifications shall be rejected. No repair by welding or other means will be permitted.

All cast pipe shall be hydrostatically tested to 5,900 p.s.i. and held at that pressure for 20 minutes with zero pipe leakage. Each length of pipe shall be hydrostatically tested at the manufacturer's plant.

Radiographic Inspection

(a) Paragraph S5 (a) of the Supplementary requirements of ASTM-A 362-52T.

(b) All castings shall be radiographed 100% and shall conform to ASTM-E7 1-52, Class 2 quality, except as modified by these specifications.

(c) The manufacturer shall establish a positive system of identification of the X-ray plates which shall be subject to approval by the inspector. This system shall guarantee complete coverage by radiographing and provide for positive identification between the plate and the subject.

Inspection of Penetrants

All castings shall be subjected to inspection by fluorescent penetrants or penetrating dyes both inside and out. All cracks, porosity, or flaws revealed as a result of the Dye Penetrant Test shall be due cause for rejection of the casting.

The 304L stainless steel shall conform to the following ladle analysis:

Carbon	.03 max.		
Manganese	1.50% max.		
Phosphorous	.03% max.		
Sulphur	.03% max.		
Silicon	2.00% max.		
Chromium	18.00	-	21.00%
Nickel	8.00	-	11.00%

Pipe: All pipe of the following sizes shall be centrifugally cast stainless steel as per ASTM-A 362-52T, except as modified by these specifications:

16" - Sch. #160
12" - Sch. #160
10" - Sch. #160
8" - Sch. #140

All pipe shall be machine finished to 125 micro-inch interior and exterior.

Not all is **BLACK** that meets the eye...

For clean, crisp, opaque drawings -

Use Imported Castell

"saturated" with graphite of more than 99% carbon

Masters the world over have long known it. If you are a young creative man on the way up, you will do well to find out for yourself why imported CASTELL is hailed as The Drawing Pencil of the Masters.

Make a series of single and multiple pass lines with your CASTELL. Now examine them carefully with your magnifying glass. Note how each grade gives its own consistency of black in non-feathered lines of unvarying width, pencil after pencil. You will find this true even if you lay aside a drawing and resume work on it months or years later.

CASTELL is saturated with "black gold" graphite—a natural crystalline allotropic form of carbon that has been microlet-milled to produce granules of perfect cohesion. No oily substances are added to give the *illusion* of black. Its low index of friction enables you to work smoothly, effortlessly, hour after hour, with almost no fatigue.

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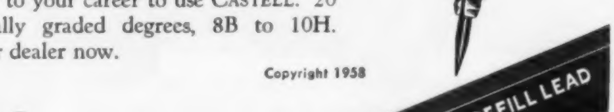

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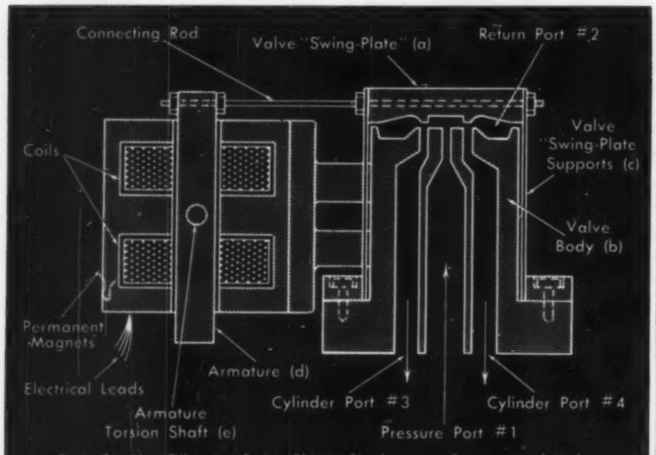
. . . *Fluid Power* **news**

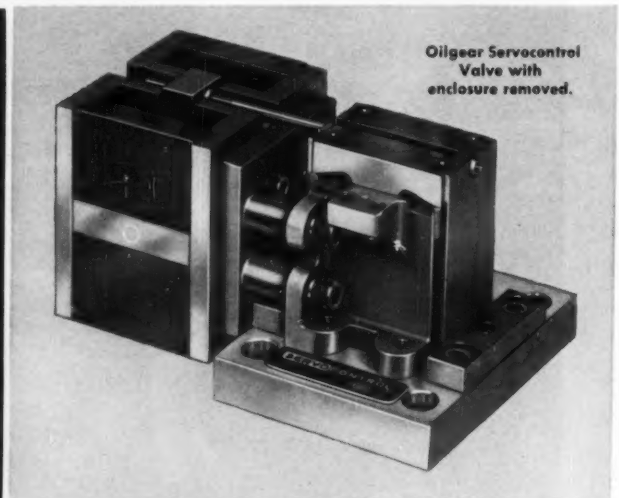
NEW INDUSTRIAL SERVO-CONTROL VALVES

New Oilgear Electrohydraulic Servocontrol Valves

SERVO VALVE DESIGN OBJECTIVES: 1: Greater control accuracy and resolution for rotation and straight-line drives. 2. For industrial applications, must be capable of controlling wide pressure and volume range with single-stage, fast response to a low input signal. 3. Eliminate conventional valve frictional problems between spools and cylinders. 4. Eliminate two-stage linkage and stability problems. 5. Eliminate first-stage pilot systems — supply pressure, centering devices, filters, and orifices required for pilot systems. 6. Provide a flow rate substantially linear to valve displacement, with stability in null position. 7. Eliminate or substantially reduce valve "dead-band," sticking, jamming, scoring. 8. Be "fail-safe." 9. Operate safely in hazardous locations.



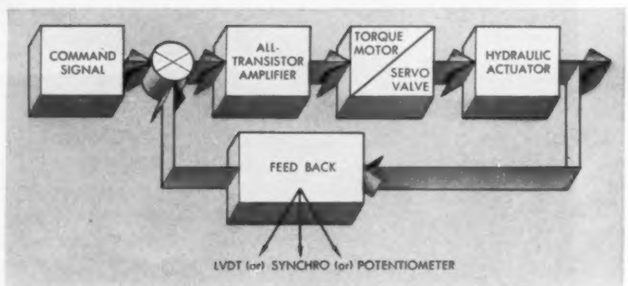
Cross-Section Oilgear "Swing-Plate" Single-stage Servocontrol Valve
*Patent Pending


Oilgear Servocontrol Valve with enclosure removed.

SOLUTION: **1.** A new concept of three and four-way single-stage electrohydraulic servo valve construction . . . only two moving parts in Oilgear's new "Swing-Plate" design. **2.** No metal-to-metal contact between "Swing-Plate" (a) and valve body (b) . . . frictionless for high sensitivity, fast response to minute signals — virtually eliminates sticking, scoring, jamming. **3.** Clearances and port seal sizes can be varied to suit application and fluid handled. **4.** Sharp, long rectangular chambers and lands linearize valve characteristics — flow rate essentially a linear function of valve displacement . . . supply high fluid power gain with minute "Swing-Plate" movement. **5.** Hardened stainless steel construction assures reliable operation well in excess of a hundred million cycles, even with non-lubricating fluids. **6.** No pilot system pressure, centering devices, orifices, or internal filters required. **7.** Spring-steel supports (c) respond instantly to low torque motor forces. **8.** As torque motor armature (d) pivots on torsion shaft (e), valve automatically centers in event of power failure for "fail-safe" operation. **9.** For operation above 500 psi, a compensating cap equalizes hydraulic forces to maintain selected clearances. **10.** No special modification required for use in hazardous locations. **11.** Valves — open or enclosed — can be gasket-mounted. Pipe tap subplates are available.

PERFORMANCE DATA: Flow Rate—4 gpm at 250 psi; 8 gpm at 1000 psi pressure drop across valve. Supply Pressures—to 3000 psi. Torque Motor; Mid Position Force—11 lb min.; 5 watts max. power demand; Stroke — ±0.015 inches; Hysteresis—less than 3%; Differential Current —150 ma; Resistance per Coil—80 ohms. Other coil current and resistance values available. Net Weight—4¼ lb. Width: 4⅜"; Height: 2¾"; Depth: 3".

Oilgear can supply all components for Fluid Power Servocontrol systems . . . all-transistor amplifiers, manual controls, preset controls, two-stage servo valves, variable displacement pumps, variable speed drives, motors and cylinders.



New Oilgear Servocontrol components applied to controls on Oilgear pumps and transmissions provide greater system accuracy and resolution. Functions easily attained with new Oilgear Servocontrol open and closed-loop systems are: 1. Precision, high-response speed control from zero to maximum rpm in either direction through remote control stations or switches. 2. Positive, high response, follow-up position control through remote command units. 3. Output motions or speeds with closed-loop systems will remain near constant with accuracies from 0.1% to 1.5%, and with resolution down to 0.05%.

For further information on these new valves and systems, call your Oilgear Application-Engineer. Or write, stating your specific requirements, directly to . . .

THE OILGEAR COMPANY

Application-Engineered Controlled Motion Systems

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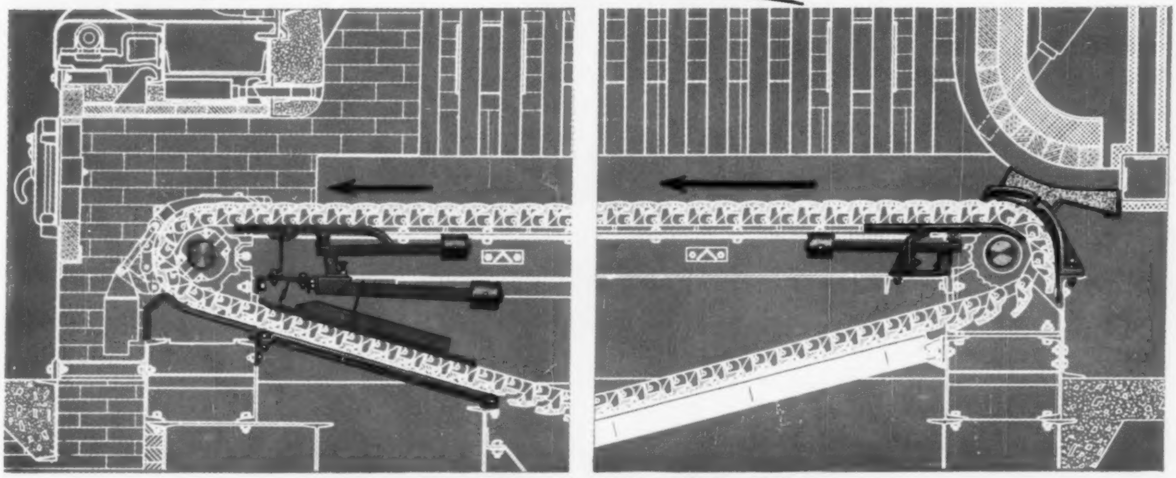
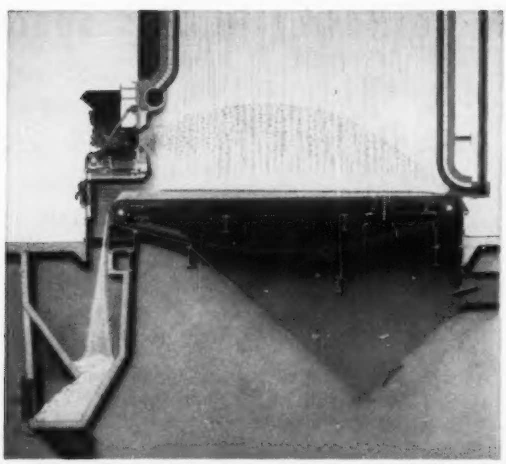
DOWN WITH EXCESS AIR!



Floating Front and Rear Grate Seals—A Detroit RotoGrate Exclusive.
They decrease excess air.

Automatic Air Seals Exclusive With Detroit RotoGrate Stokers Reduce Excess Air to 22% and Lower



Detroit RotoGrate Stoker — an advanced design spreader stoker with forward moving grates, for medium and large boilers. Burns all ranks of bituminous coals and lignites without special preparation . . . also many waste or refuse fuels, either alone or in combination with coal. Efficiency is high — maintenance low.

Many users reduce excess air to 22% or under, due to these free floating automatic front and rear seals with adjustable counterweights. They really seal, and stay sealed even after years of service. Air is directed to the active combustion zone. The result is increased combustion efficiency and economy.

The rear under-grate seal plate provides a quiet coking section which extends across the furnace . . . expedites the ignition of green fuel.

These and many other exclusive features of advanced design make Detroit Stokers your best buy. There is a type and size Detroit Stoker for any boiler capacity from 3,000 to 400,000 pounds steam per hour.

DETROIT STOKERS COST LESS: COST = INITIAL INVESTMENT + UPKEEP + PRODUCTION LOSSES DUE TO EQUIPMENT OUTAGE. THE TOTAL IS LESS WITH DETROIT.

DETROIT STOKER COMPANY

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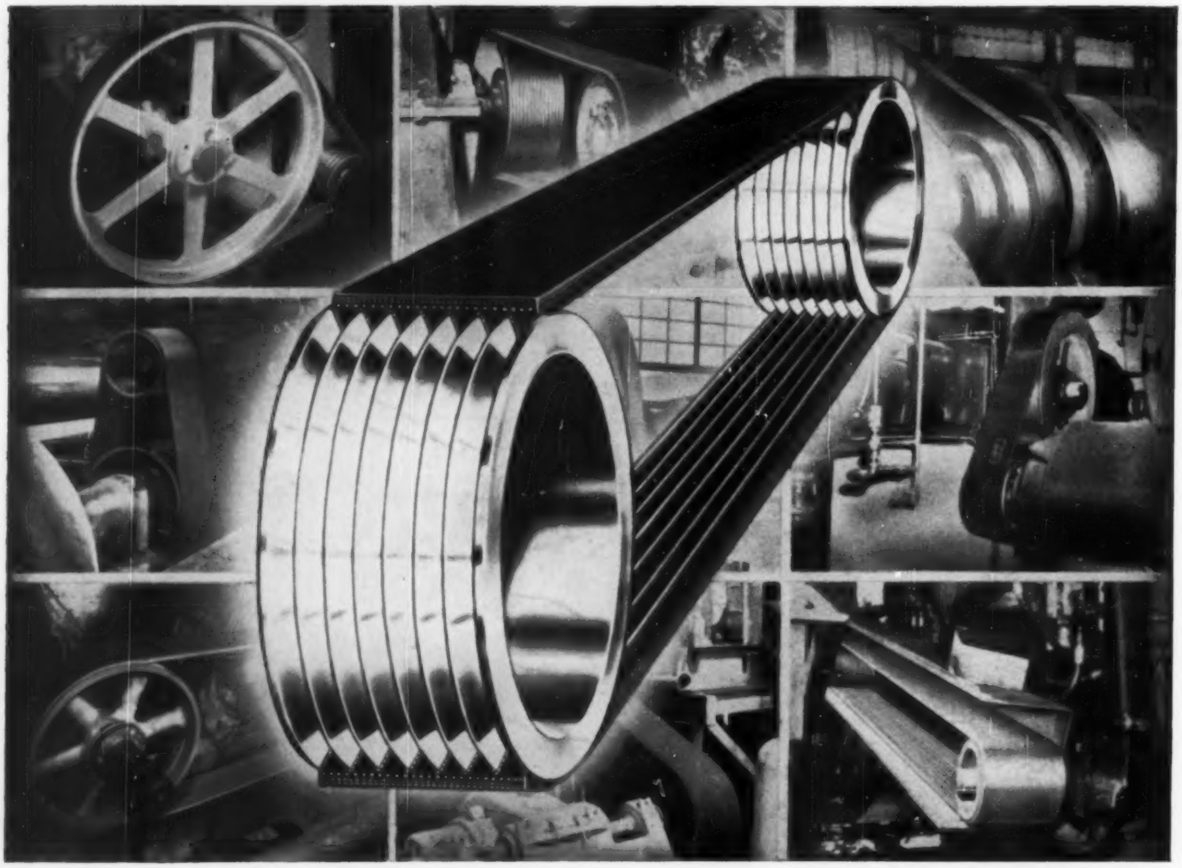

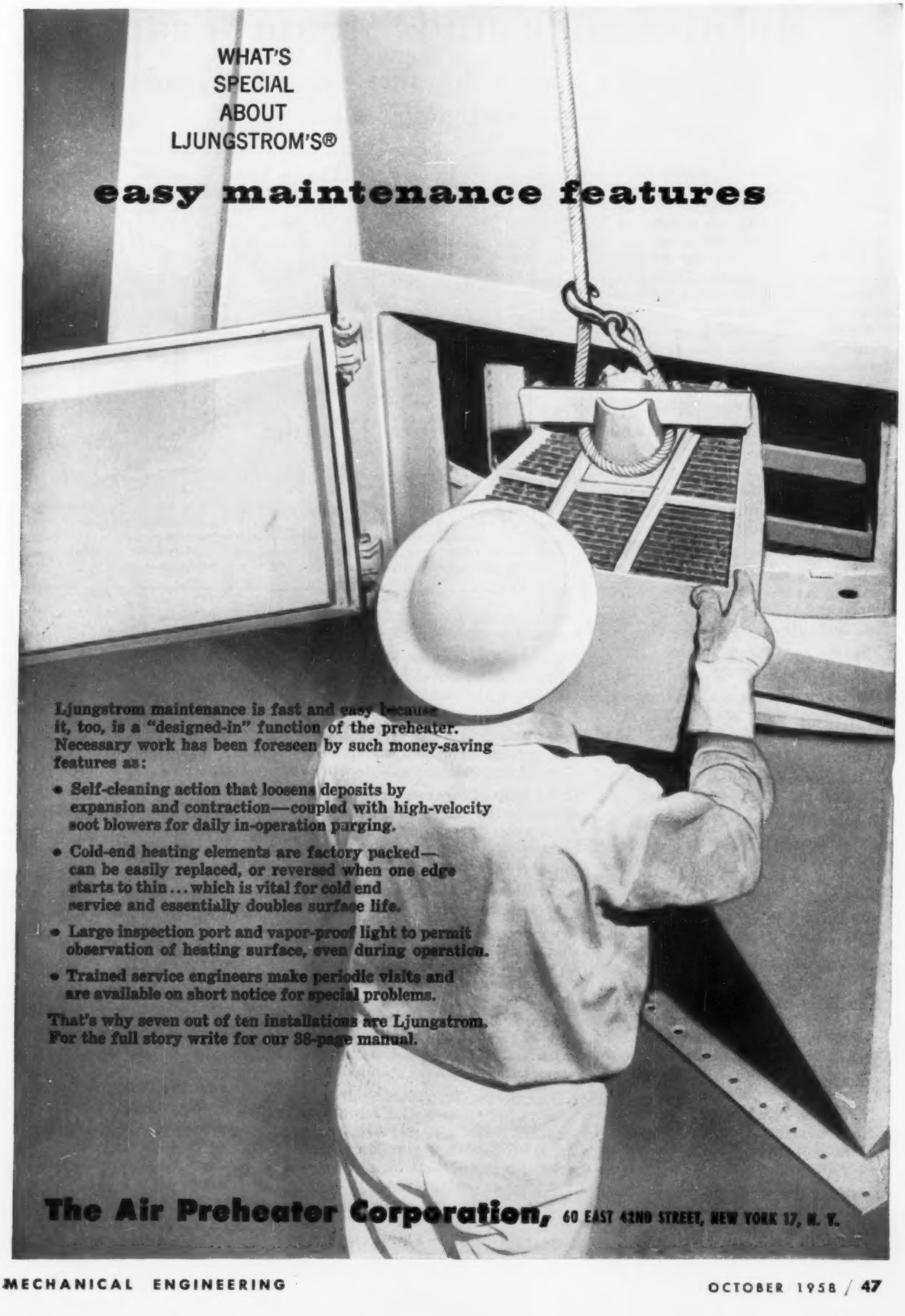
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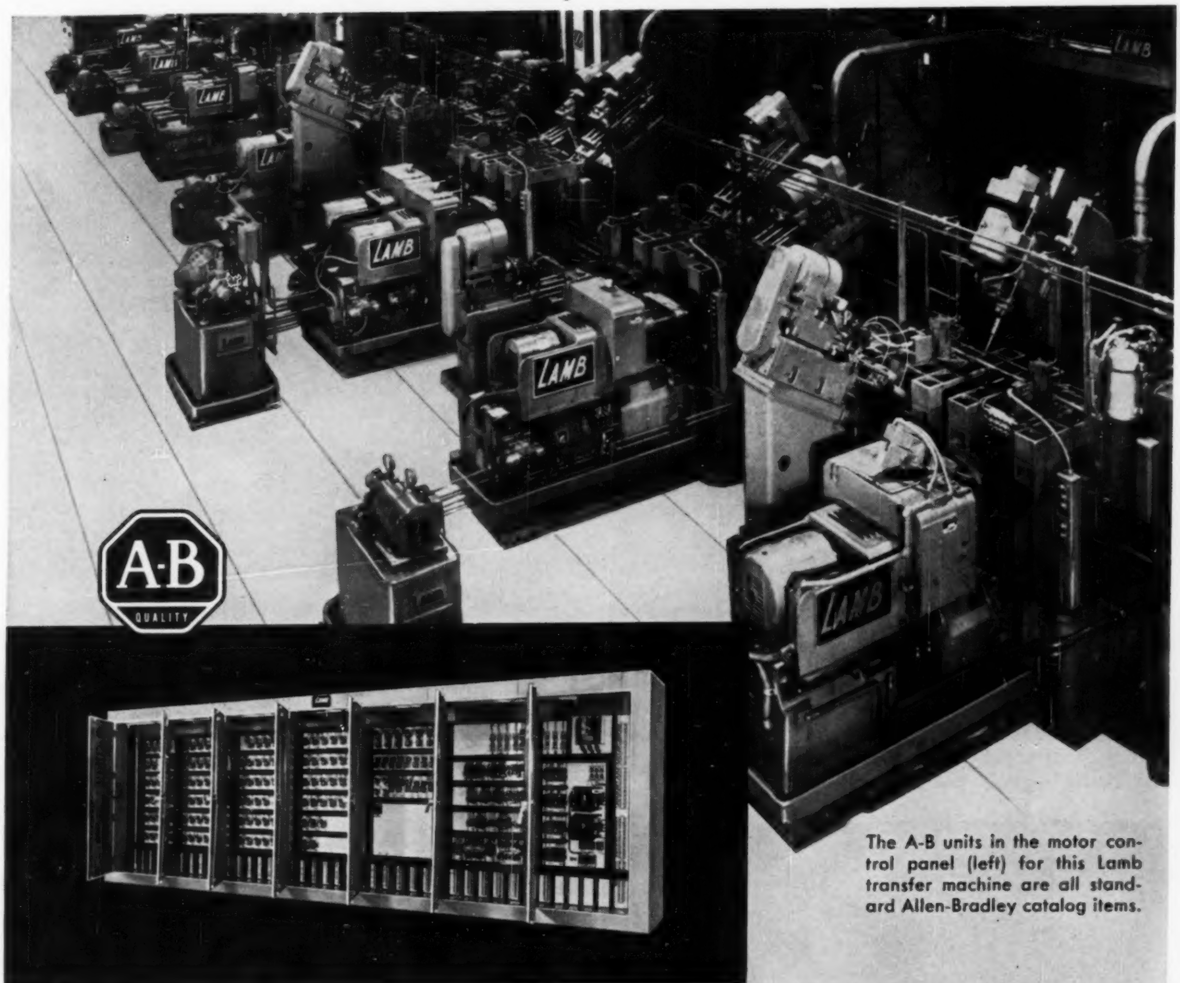
LJUNGSTROM'S®
easy maintenance features
Ljungstrom maintenance is fast and easy because it, too, is a "designed-in" function of the preheater. Necessary work has been foreseen by such money-saving features as:
• Self-cleaning action that loosens deposits by expansion and contraction—coupled with high-velocity soot blowers for daily in-operation purging.
• Cold-end heating elements are factory packed—can be easily replaced, or reversed when one edge starts to thin... which is vital for cold end service and essentially doubles surface life.
• Large inspection port and vapor-proof light to permit observation of heating surface, even during operation.
• Trained service engineers make periodic visits and are available on short notice for special problems.
That's why seven out of ten installations are Ljungstrom. For the full story write for our 38-page manual.
The Air Preheater Corporation, 60 EAST 42ND STREET, NEW YORK 17, N. Y.



The A-B units in the motor control panel (left) for this Lamb transfer machine are all standard Allen-Bradley catalog items.

Inco Nickel Alloys
. . . for wire mesh in severe environments

For corrosion, abrasion resistance

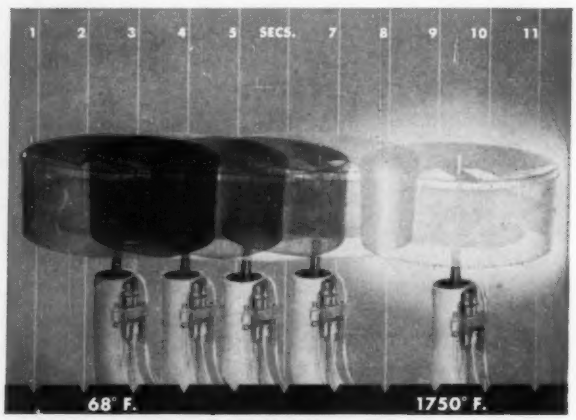
This lint filter is a big reason why housewives buy RCA® Whirlpool automatic washers. Made of a lightweight Monel* nickel-copper alloy mesh, it can withstand practically all household acid and alkaline solutions . . . stands up to clothes grit, too. Monel mesh is easily formed, brazed, welded. And . . . in fine meshes, it's priced especially low.

For high conductance, caustic resistance

The plates in long-lived nickel-cadmium batteries are sintered carbonyl Nickel powder reinforced with nickel wire mesh. Strong Nickel mesh is proof (1) against the high sintering temperatures used in plate manufacture (2) against embrittlement or corrosion from the potassium hydroxide electrolyte (3) against contamination by foreign ions.

For "hot" strength, oxidation resistance

At the Progressive Metal Treating Co., heat-treating trays lasted about 7 months – until they were made of Inconel* nickel-chromium alloy. These trays are used in carburizing, nitriding, annealing of small steel parts. They withstand heating to 1750°F, quenching to 150°F oxidation, in a gas fired furnace. After 30 months, trays are still in daily use.



For cyclical thermal shock

Radiant elements like this are fired from cold to 1750°F in 11 seconds—thousands of times! Incoloy* nickel-iron-chromium alloy element is part of a gas conversion burner made by the Abbott Equipment Co. Incoloy wire mesh stands up to thermal shock, high temperature oxidation and creep. Easy to form, braze, weld. Priced competitively with less durable materials.

*Registered trademark

*Use meshes of Inco Nickel Alloy to improve your product, cut manufacturing costs—check with your wire cloth supplier.*** INCO *THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall Street, New York 5, N.Y.*

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INCO NICKEL ALLOYS

MECHANICAL ENGINEERING

VOLUME 80 • NUMBER 10 • OCTOBER, 1958

Two Pioneers...

The deaths, on August 9 and 12, respectively, of W. F. Durand and George B. Pegram recall the pioneering services of these men in aviation and nuclear engineering that have had dramatic impacts on our lives; and they also recall the great debt which engineers in general and The American Society of Mechanical Engineers in particular owe to both of them.

William Frederick Durand, born March 5, 1859, began his professional career in 1880, the year of the founding of ASME, as a graduate of the U. S. Naval Academy. He was assigned to duty on the *USS Tennessee*, flagship of the North Atlantic Squadron, "a wooden cruiser, the largest ship in the Navy of those days and of about 5000 tons displacement. She was a full rigged ship... with full steam-engine and boiler equipment for use when the wind was not favorable." He had some part in the design of the "new steel Navy"; but gradually devoted himself to the teaching of engineering under the provisions of a bill of 1878 which provided for the detail of officers of the Engineers Corps of the Navy to engineering colleges for the purpose of giving instruction in steam engineering and iron shipbuilding. His teaching career covered brief terms at Lafayette and Worcester, four years at Michigan State, 13 at Cornell, and 20 at Stanford.

Dr. Durand's extensive studies and researches led engineering ever further into the fields of science and into new and unfamiliar applications. At Cornell, he states in his autobiography, his "contributions to science and research" included the introduction of logarithmic cross-section paper to the engineering world, the radial planimeter, and marine-propeller research which resulted in his well-known book, "Resistance and Propulsion of Ships" (1898). At Stanford, his studies of hydrodynamics and aerodynamics won for him a reputation in the fields of fluid mechanics and aeronautics that was to create a demand for his services during two world wars. The President appointed him to the original National Advisory Committee for Aeronautics when it was set up in 1915, and in World War I he served as its chairman. To this service he gave full time, bringing about an enduring patent peace in the aircraft industry, organizing the first training program for military aviators, directing consideration of thousands of aeronautical inventions submitted to the government during the war, and designing NACA's first wind tunnel at Langley Field, Va. He served on committees of the National Academy of Sciences, and as vice-chairman of the National Research Council, and was a member of committees on the detection of submarines by acoustic methods and helium production. As scientific attaché at the American Embassy, Paris, he was active in improving and enlarging applications of science to military problems of World War I.

Returning to Stanford after the war, Dr. Durand again devoted himself to research in a study of more than 100 airplane-propeller designs, making use of a wind tunnel he had designed. Retirement at age 65 appeared to increase, rather than diminish, his activities, particularly those relating to the public service. Indeed, so many were these assignments that he dismisses most of them with a brief paragraph in his autobiography. They included: Consultant for U. S. Bureau of Reclamation on Hoover, Grand Coulee, and Shasta Dams; service on the Morrow Board to recommend the future course of aviation in America; and reappointment at age 82 to NACA as chairman of its special committee on jet propulsion. He also found time to conceive, edit, and write certain sections of a six-volume work, "Aerodynamic Theory."

Editor, J. J. JAKLITSCH, JR.

Editor Emeritus, GEORGE A. STETSON

...W.F. Durand and G.B. Pegram

Dr. Durand became a member of ASME in 1883; served as its President, 1924–1925; and was elected an Honorary Member in 1934. He wrote many papers for ASME and other publications; was recipient of the ASME Medal, the Guggenheim Medal, the John Fritz Gold Medal, the Franklin Medal of The Franklin Institute, the John J. Carty Gold Medal of the National Academy of Sciences; and of the first award (1948) of the Wright Brothers Memorial Trophy of the National Aeronautic Association.

No brief tribute such as this can mention all of his contributions to engineering and science, nor can it adequately portray, to those who did not know him, the superior qualities of mind and spirit, the quiet industry, the friendliness, and dignity of this untiring public servant, teacher, researcher, administrator, scholar, and engineer. He was born in an era of wooden sailing ships equipped with reciprocating-steam engines; he lived to see the nuclear-powered submarine and the jet-passenger airliner. Of the rapid advances in aviation which took place in his era, he was one of those great leaders who brought an increasing amount of science into the art of engineering.

George Braxton Pegram, vice-president-emeritus of Columbia University, was born in Trinity, N. C., Oct. 24, 1876. As a physicist whose doctoral thesis at Columbia in 1903 dealt with the then new subject of radioactivity, he is best known to the world as one of the originators and leaders of the government's wartime atomic research program and to members of ASME for his service to the Applied Mechanics Division and the Metropolitan Section. In both of these activities he brought the knowledge and spirit of science into engineering and to the public notice.

Early in 1939, during a visit of Dr. Niels Bohr to America, Dr. Pegram, who from 1937 to 1949 was dean of the Graduate Faculties at Columbia, and other Columbia scientists discussed with him the splitting of uranium atoms by Hahn and Strassman of the Kaiser Wilhelm Institute, Berlin. Inspired by the prospects of startling developments in physics, Dr. John R. Dunning and Dr. Enrico Fermi, who had joined the Columbia faculty, carried out a successful experiment which demonstrated the enormous energy released in splitting the uranium atom. This event was reported by Dean Pegram to the Navy Department. The principal reason for informing the Navy, Dean Pegram said, was "that atomic energy seemed the answer to the persistent fuel problem of submarines," a fact borne out by later events. When President Roosevelt appointed an Advisory Committee on Uranium, Dean Pegram and Dr. Harold Urey of Columbia were named members of it. From June, 1940, to the late spring of 1942, when lack of space for the work on the uranium graphite pile which Dr. Fermi had devised to control the chain reaction and that on plutonium forced transfer to the University of Chicago, nearly all of the work for the Manhattan District was under Dean Pegram's supervision at Columbia.

When the Applied Mechanics Division of ASME was organized in 1927 the committee desired to have associated with it a physicist. Dean Pegram joined the Society and supported the work of the Division. He became a member of the Applied Mechanics Division's executive committee in 1928 and served as chairman in 1932, at which time he also became a member of the Professional Divisions Committee. In 1933 he was chairman of the Metropolitan Section of the Society.

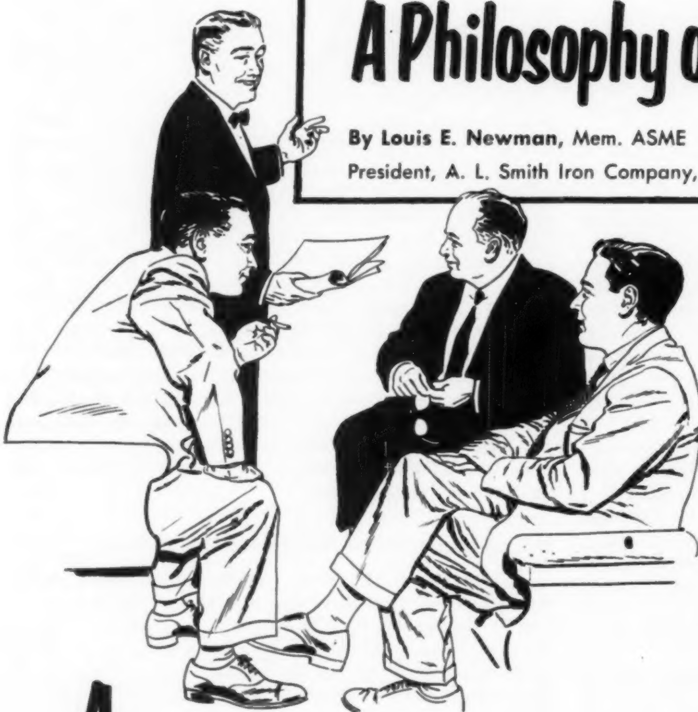
Service in technical society activities was no new experience for Dean Pegram. From 1917 to 1957, he had been treasurer of the American Physical Society, and, from 1939 to 1955, treasurer of the American Institute of Physics. He had been treasurer of the Society of the Sigma Xi for years and its president, 1949–1951. A few months before his death, in recognition of his services to his fellow physicists, he received from the hands of Prince Philip, Duke of Edinburgh, on behalf of the American Institute of Physics, the first Karl Taylor Compton Gold Medal.

Of these two pioneers, Durand approached the field of science with a practical engineering background and Pegram enriched engineering with developments in pure science. They symbolize the ever closer relationships which exist between these two great fields.—*George A. Stetson.*

A Philosophy of Management

By Louis E. Newman, Mem. ASME

President, A. L. Smith Iron Company, Chelsea, Mass.



Managers must live by their ethics, for actions will be guided first by principle and second by method. The qualities that are important to good management are not born into us, but must be acquired from our environment, from reading, and from observation of others. Personal integrity is probably the most important quality, for the man who chooses the course of doing what he thinks will be most popular is usually a little pathetic, and rarely gets the high praise and respect given a true leader.

A MANAGER's philosophy may be more important to his future success than his skills, for his future actions will be guided first by principle, and second by method. It is much like planning a trip—usually you decide *where* you want to go before deciding *how*. Similarly, in business, decisions on principles must be made before solutions to specific problems are attempted. Such principles are needed to answer such questions as:

Should promotion be from within, or should the best qualified candidate be sought whether inside or outside the company?

Should compensation be geared primarily to length of service, or to performance?

Should precedent be followed, or should written objectives, policies, and principles be relied on for guidance?

Usually the principles being followed have never been stated and thus are differently understood by men applying them within the same organization.

Some of these philosophical decisions will be explored within the framework of the author's company. This might be called a large, small company with a main plant and three satellite plants employing about 600 men and women, and an annual volume of about $10 million.

Management starts when the managers of a business accept a common body of continuously evolving principles to guide them in their day-to-day decisions. Of course, what fits one business may not fit another, and what fits a manufacturing type of business may not fit the service type of business. What is thought best today may be different in the future.

Based on a talk presented at the Engineering Management Conference, Boston, Mass., March 19–20, 1958, sponsored jointly by the American Institute of Electrical Engineers and The American Society of Mechanical Engineers.

Good Employee Relations Start With Sound Organization

Some of the most trying situations in which men find themselves have had their roots in poor organization. Severe friction often results where: Two men have been given the same responsibility; a man reports to more than one boss; no one knows who is supposed to be the boss; or men are held responsible for situations in which they have no real authority.

One of the outward signs of poor organization is the manager's plea to his men to pull together—to act as a team. With proper assignment of responsibility, coupled with proper authority, and each man held accountable for his actions, it seems a little superfluous to ask men to pull together—that's their job!

There are some tests for good organization that are easy to apply and often reveal some of the more obvious errors in good structuring: (*a*) Is the organization chart on paper and widely in use as a guide to responsibility and authority? (*b*) Does each man report to only one boss, and clearly understand that this is so? (*c*) Is each area of responsibility assigned to only one man, and is this in writing? (*d*) Does communication travel freely throughout the organization?

An organization without sharp, clear delegations of

authority is like a basketball team with a coach who doesn't tell the men what positions they are supposed to play.

Men's Destinies Should Rest on More Than One Man's Opinion

This is easier said than done, for when a manager has authority to act, it usually includes the power to hire and fire. There are some protections that can be given employees, but none is more important than having each supervisor feel that he wants to enlist every possible aid before forming an opinion that will vitally affect the job of one of his employees. There was once a time in our factories when a foreman could fire a man without cause. This is seldom true today, but in effect it is true of many jobs.

Our company has a stated policy that requires two levels of supervision to concur in any change that vitally affects the status of any employee. Specifically, this is intended to protect the employee and the company against poor judgment in matters such as hiring, firing, increase or decrease in pay, or change in organization structure. It is not intended to lessen the power of a supervisor to act with authority, but rather to give assurance that he will take counsel with someone having an objective and detached viewpoint.

In addition, our supervisors are encouraged to go through a four-step selection process when they are choosing a candidate for a promotion, or hiring a new employee. They consider: (*a*) What he has accomplished; (*b*) what others capable of judging his competence think of him; (*c*) what their own opinion of him is; (*d*) what the results of psychological tests are.

In these evaluations, it is expected that no single factor will be enough to either elect or reject a candidate, but that each will tend to shed light on the others.

Many of us are familiar with the common practice of psychological testing as an *aid to*, but not a *substitute for*, good judgment. The most ardent advocates of these tests do not guarantee 100 per cent accuracy, yet a number of top executives place complete reliance on them.

In one case—not in our company—a man was given a job for which he had outstanding qualifications and, almost as an afterthought, given a battery of tests a week later. He did poorly on these tests and, without further trial on the new job, was taken off it. The person who did it stated that he had known the employee for 24 years and always thought that he was outstanding until he saw the weaknesses the tests revealed. Fortunately, the employee found a job with a wiser boss and continues a successful career.

Promotion Goes to the Most Able

Although this sounds simple, there are serious problems involved in putting it into practice. Some companies pride themselves on a promotion-only-from-within policy, yet such a policy automatically says that the best qualified candidate will not always be chosen, since it can hardly be true that the best qualified candidates are always to be found within the company.

A second problem arising when you promote the most able is the disappointment of passed-over candidates who feel that they are more able. They may, in fact, be more deserving from the standpoint of having worked harder, or longer, or being older, or even in feeling more loyal. The "most able," from the standpoint of being best qualified, may not be the most deserving from certain other standpoints. In order to apply the principle of promoting the most able, certain guiding subprinciples are needed. Ours are: (*a*) Evaluate what a man *has done* as a guide to what he *will do*—it is the "will do" on the job ahead that is significant; (*b*) distinguish between breadth of experience and repeated experience—20 years' experience may really be one year's experience repeated 20 times; (*c*) search outside the company for a job candidate only when there is no fully qualified candidate inside the company; (*d*) when two or more candidates are equally qualified, select the younger one—this is sometimes rough on older men, but it is essential to the vitality and continuity of an organization.

The protection for us older men is that we have had more time to prepare ourselves for the job ahead, and thus should be better qualified than our younger competitors. Of course, there is no substitute for the experience and maturity of judgment provided by a company's older employees.

Managers Should Be Tough, But Never Brutal

To define one of these terms, "toughness" should mean that a manager must analyze a problem objectively, decide on the best solution, and then see that it is carried out. He must have the courage and stamina to do what needs to be done for the over-all health of the business, but his actions should have a quality of warm, human consideration that takes into account the pride and feeling of affected employees. Malcolm P. McNair, of the Harvard Business School, has said that managers should be tough-minded but not tough-hearted.

An example comes to mind of the not uncommon practice of taking a responsible employee off his job without warning, and having his replacement take over on the same day he is notified of his release or demotion. The resultant shock is often a brutal one. Of course there are cases where this is the only reasonable way to handle certain situations, but in most cases advance warning can be given of impending changes that will help the employee to adjust to the new situation.

An employee is also entitled to know in advance in what way his work falls short of what is required of him and, when possible, to be given a chance to correct his deficiencies. One way that managers can be sure that they don't take a man off his job without giving him a chance to improve, is to schedule annual appraisals of performance with each employee.

Employees Should Know What the Boss Thinks of Them, and Why

We can't pick our parents, but we can change our bosses by changing our jobs. And let's not kid ourselves that most of us have much of a future if our boss doesn't think pretty well of us. The trouble is that many bosses leave their employees in doubt as to their true feelings.

In order to encourage our supervisors to tell each employee just how he stands, we plan to schedule annual discussions at the time of an annual salary review. This

doesn't mean that salaries cannot be reviewed at any time, or that meetings can only be held once a year. Rather, it is an attempt to assure each employee that his salary will be reviewed at least annually, and at that time his boss will give him an appraisal of his performance. So far we have not extended this to our unionized employees. Perhaps we should!

Managing must never be a popularity contest. Each man chosen to be a supervisor consciously or unconsciously makes an important decision early in his career. He decides that he will do what he thinks is right, or he decides that he will do what he thinks will be popular. The man who chooses the course of trying to do what he thinks will be most popular is usually a little pathetic. He tries so hard to be liked, and often is, but more often fails as a supervisor, rarely getting the high praise and respect given a true leader.

Managers Must Live by Their Ethics

Ethics are not born into any of us. They are acquired from our early environment, from reading, and from observation of others. The ethics of a manager guide him and those around him through many critical situations, but they are rarely written, for then they tend to sound like platitudes. Actions speak louder than words, or as Emerson has stated, "What you are. . . thunders so that I cannot hear what you say. . ."

Probably the most important single quality of a top manager is personal integrity. In these days of tax-dodge temptations, opportunities to featherbed, chances to play favorites, times to get free entertainment, and opportunities for unfair self-advancement, the manager's ethics will be apparent to those around him. The large majority of the men reaching top positions have done so in no small measure because of standards of integrity that commanded respect.

Set Precedents When It Seems Proper to Do So. The question, "Wouldn't we be setting a precedent?" has hindered many a desirable action. Good precedents are good things to set, and bad precedents need not be continued. It was Emerson who said, "A foolish consistency is the hobgoblin of little minds. . ." or, as Harold F. Smiddy of General Electric has said, "Leaders can't also be copiers of what others have already done."

Each Man Should Decide His Own Destiny

In William H. Whyte's book, "The Organization Man," there is a chapter titled "Checkers." It closes with a quotation from a young executive who has been transferred from city to city a number of times by his company. He says, "I'd hate to lose all that is behind me because somebody is playing checkers with me."

Companies are playing checkers to a surprising degree with the lives of their employees, and the further fact is that the checker players often are poorly skilled. The unfortunate result is often the capricious movement of men and their families with consequent loss of roots and sometimes of objectives.

Most such job changes are very much in the interest of the employee, rounding out his experience and qualifying him for better positions. The employee himself should evaluate carefully the proposed new job and consider what it offers. He should realize fully that opportunity and security are not bedfellows.

Certain job changes, particularly the city-to-city kind, may be in the interest of the company but of doubtful value to the employee. Employees for whom a move is contemplated should be told frankly the "pros and cons" of a new job, and given the opportunity to accept or reject the job without prejudice. While it is true that each time a man turns down what his manager thinks is an opportunity for him, he is less likely to be considered for future jobs, this in no way lessens his obligation to himself to make his own appraisal, rather than trustingly putting his development entirely in the hands of others.

Good experience is essential for growth, but all experience is not good experience.

Compensation Should Be Based on Contribution

It sounds pretty elementary to say that we should pay for what we get, but compensation in most companies is based on three elements. These are: Past service, present contribution, and expected future potential. Of these three, present contribution should receive the greatest weight. We take this for granted when we buy something, or pay the doctor or lawyer, yet we may see nothing odd about paying an older employee much more than a younger employee who is doing a better job, and we accept as necessary the overpaying of some employees based on their need rather than on their contribution.

It is certainly proper that a company recognize the value of its long-service employees, but there is danger in overvaluing length of service or age. Similarly, there is danger in overvaluing expected future contribution. Some of the most promising young men fall by the wayside in their upward climb, while some of their less promising contemporaries go far beyond what seemed likely when they were young men. There are factors influencing a man's growth which we have not yet learned how to evaluate. These include such things as continuing motivation, health and energy, ability to get along with others, family demands, and many others.

The point is that future potential, while important, is elusive—present contribution is real and measurable.

What You Do, Not What You Know

There is a feeling widely held that if you know the right people, or have the proper "pull," promotion is automatic; but it would be more correct to say that, "Promotion is not based on *what* you know, or *who* you know, but is based on what you *do* with what you know."

Young men leaving school to go to work must be especially mindful of this principle. In school, good grades go to the student with the most knowledge, but later, although it may seem harsh to say so, few will care what the student knows. Their interest will be entirely in what he does with what he knows.

There are two very good quotations on the day-to-day job of being a manager. The first from Lewis K. Sillcox, a former president of ASME, cautions against making decisions without all of the facts: "Prejudice is a great time-saver, it enables one to form opinions without bothering to get the facts." The other, by Reinhold Niebuhr, is in the form of a prayer:

"Give me the serenity to accept what cannot be changed.
Give me the courage to change what can be changed.
The wisdom to know one from the other."

QUICKENING FOR FINER CONTROL

In a man-machine control system, the man is in some respects a second-rate instrument. To improve stability and precision, the designer may strive to reduce dependence on man's perception and reaction. The transfer of analog differentiation to the machine itself is called "quickening."

By H. P. Birmingham and F. V. Taylor

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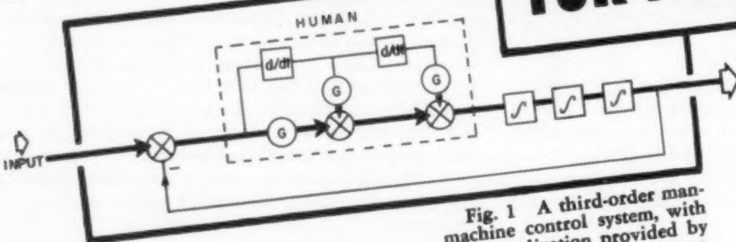

Fig. 1 A third-order man-machine control system, with stability equalization provided by the human operator

As a machine operator, the human being is limited in bandwidth. In a closed-loop control system, the man is not likely to furnish bandwidth exceeding $^1/_2$ to 1 cycle per sec.

Man is basically a single-channel, single-process device. He exhibits maximum bandwidth in a control task where he is required to perform in only one channel.

The precision of human operation is quite low. In a linear control system, there are four basic functions: differentiation, integration, addition, and multiplication by constants. When the human differentiates, as in estimating velocity, the error is likely to be 10 to 50 per cent. One can construct a highly accurate automobile speedometer; but unless some secondary cue such as resonant points in the engine at known speeds is used, the driver, or a pedestrian observing the car's passage, does a relatively poor job at estimating its speed.

As with differentiation, so also with analog addition, in which human accuracy will range from 5 to 10 per cent on up. Multiplication by a constant is another analog process which the human is ill-equipped to perform. Since analog integration by man will involve both multiplication and time judgment, it is obvious that his ability to perform analog integration will be very poor.

The human in a closed-loop system is a source of noise. Frequencies which do not exist in the system input will be observed in his control movements. These stem from tremor and from other sources of inaccuracy in his response, and from the interaction between the human, with his inherent transmission delay, and the dynamic properties of the rest of the system. All of these frequencies are normally higher than those of the input system.

The human gain varies among individuals and is highly variable from time to time within the individual.

Designer's Decision

It is important that human characteristics be considered in deciding which functions in a closed-loop control system will be performed by the man, and which by electronic, electrical, or mechanical components. This report will take up the changes made in a system which reduce or eliminate the necessity for the human operator to sense or compute derivative information, in order to make the system stable.

Suppose that a man is inserted in a third-order control system (three cascaded integrators), as in Fig. 1. To simplify, let us assume that the human has no transmission delay. In order that the system operate with reasonable stability and accuracy, the human must exhibit the characteristic shown in Fig. 1. Here the man is performing the following analog processes:

1 Differentiating and double differentiating (establishing the first and second derivatives of the error).

2 Putting weighting factors on each of 3 terms (multiplying by constants).

3 Adding the weighted factors algebraically in two cases.

A man-machine control system putting this requirement on the human will not achieve a high degree of performance accuracy for the following reasons:

1 Since there are seven tasks which the operator must perform, the amount of his available bandwidth which can be devoted to each task will be quite small.

2 The accuracy with which he performs each task

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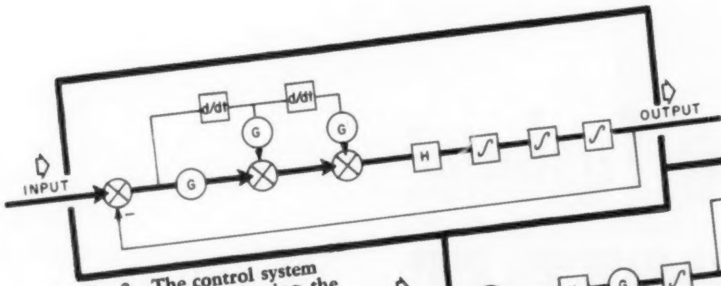

Fig. 2 The control system equalized by quickening the display—stabilizing terms are inserted ahead of the operator

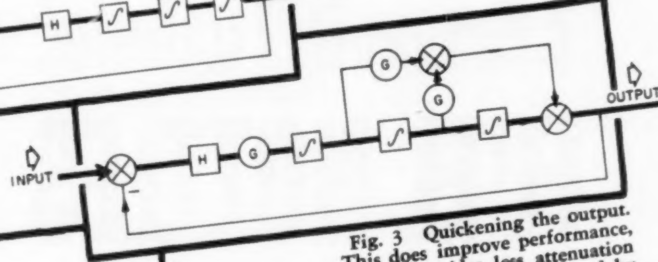

Fig. 3 Quickening the output. This does improve performance, but provides less attenuation of the "noise" inserted by the operator.

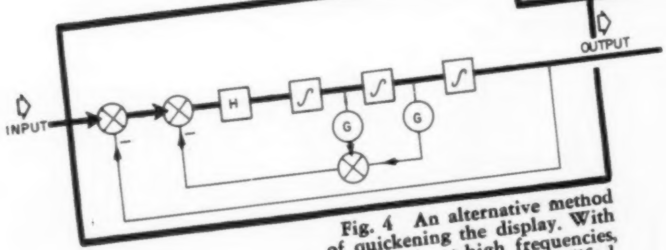

Fig. 4 An alternative method of quickening the display. With less gain at high frequencies, human noise will not be amplified.

is very low compared with the accuracy with which it would be performed by "hardware" components.

3 Since the error signal must pass through his "noisy" and intrinsically nonlinear visual sensing system, it is apparent that second-derivative information, even if his double-differentiating ability were high, would be almost worthless.

Operator Receives Processed Data

One method of improving the performance of such a man-machine system—relieving the human of these analog-processing requirements—is shown in Fig. 2. It involves appropriate analog processing of the error prior to feeding the signal to the human.

But the error (ϵ) is not always directly accessible for processing.

Such is the case in optical tracking with a telescope, where the actual subtraction of the output (telescope reticle position) from the input (relative target angle) occurs in the eye itself. Also the performance of electronic or mechanical double differentiation is, in many cases, impractical. However, there may still be applications where the general technique of Fig. 2 will furnish a useful method of equalizing the system.

Another approach toward relieving the operator of the elaborate analog operations is shown in Fig. 3. If all elements in this system were linear and noise-free, and if appropriate gain corrections were made, the transfer function of this system would be identical with that of Fig. 2. In practice, this type of "output quickening" does result in greatly improved performance. However, it has one disadvantage over the equalization of Fig. 2. The part of the system beyond the human (H) in Fig. 2 will have a −18 db/octave slope on a Bode plot. When modified, as in Fig. 3, the slope will be changed to −12 db and then to −6 db at the higher frequencies. Since the human actually inserts high-frequency noise into the system, this arrangement will provide much less attenuation of this noise than that of Fig. 2.

A third and far better approach is illustrated in Fig. 4. This is referred to as "display quickening" because the stabilizing terms are inserted ahead of the human. To the operator, this system "feels" identical with the other two equalized systems. That is to say, he is not required to exhibit derivative operation in order to make the man-machine system stable. The over-all transfer function of the system will be far less sensitive to variations in the human operator's gain.

In electronic system design, if one of the necessary components fluctuates in gain, and this has a harmful effect upon system performance, a standard technique is to place a high-gain negative feedback loop around this element and to compensate the lost gain elsewhere.

The same technique applies equally well to the human operator. The placing of a tighter feedback loop around the operator, as in Fig. 4, provides a local loop, containing the human operator, the gain of which is far more stable than the gain of the operator himself.

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Erosion in Turbojet FUEL NOZZLES

By H. R. Hazard,[1] Mem. ASME, P. Gluck,[2] and R. W. Tate[3]

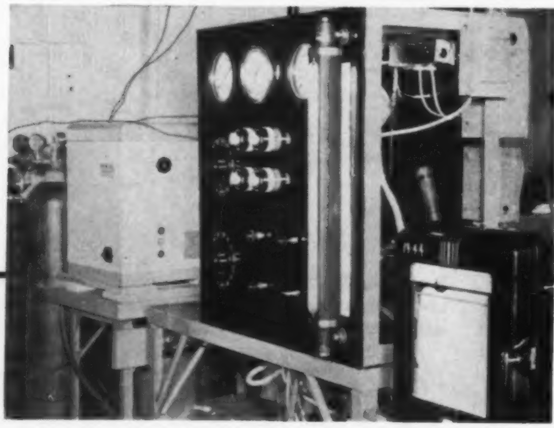

Fig. 1

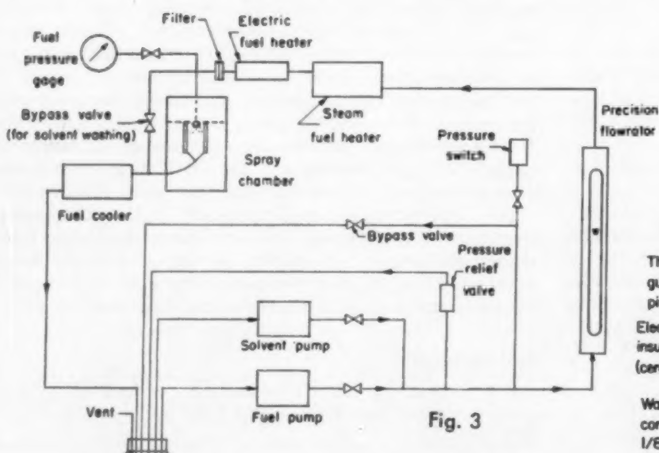

Fig. 3

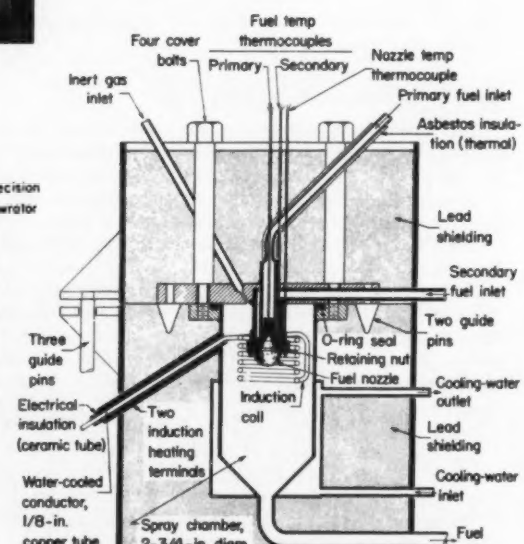

Fig. 4

It could have taken hundreds of hours of engine operation in altitude test chambers. It didn't. At Battelle Memorial Institute, radiochemical techniques made possible studies of many nozzle designs at reasonable cost in a relatively short time.

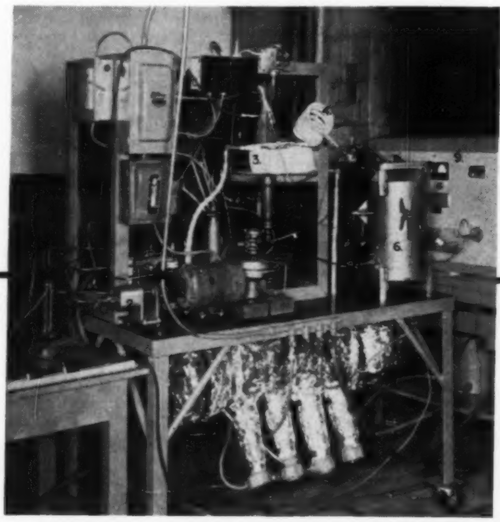

Fig. 2

Fig. 1 Front view of the apparatus for study of nozzle erosion. The panel includes pressure gages for fuel, steam, nitrogen, and compressed air: Also electric controls for fuel heaters, and valves for controlling flow and pressure through the test nozzles.

Fig. 2 Behind the panel. 1, Fuel reservoir; 2, fuel pump; 3, steam fuel heater; 4, electric fuel heater; 5, fuel filter; 6, lead-shielded nozzle housing; 7, fuel cooler; 8, electric boiler; 9, induction heating supply.

Fig. 3 Fuel circulation system. The irradiated nozzle discharges into the spray chamber in which a nitrogen atmosphere is maintained to avoid burning of the fuel.

Fig. 4 Lead-shielded nozzle housing. The spray chamber is a stainless-steel vessel for pressures up to 200 psi. Both the cover and bottom are positioned in an outer housing of cast lead to provide 3-in. shielding.

In advanced turbojet engines now entering service, fuel nozzles are exposed to conditions much more severe than those in previous engines. The temperature of air entering the combustor and cooling passages in the nozzle may be as high as 1200 F, and the front of the nozzle is exposed to flame at high pressure and temperature. In addition, the fuel is used as a heat sink and may enter the nozzle at 400 F or more, increasing the possibility of cavitation. Some nozzles suffer severe erosion under these conditions; others do not.

Experience with operational engines and experimental engines in test cells has not helped in establishing the variables which influence erosion rates. Test periods as long as 100 hr are frequently required to produce visible erosion, and test conditions vary widely over a 100-hr period of operation. The cost of running special tests just for nozzle evaluation is prohibitive.

This paper details an erosion study made by the Battelle Memorial Institute for the Delavan Manufacturing Company, in which a laboratory procedure for simulating engine conditions was developed and a radiochemical technique was perfected for measuring erosion of a few millionths of a gram of material in a few hours.

Simulating Engine Conditions

Figs. 1 and 2 show how the test apparatus appears in the laboratory, while Fig. 3 shows it in schematic diagram. Hot fuel is circulated for several hours through an irradiated nozzle. Metal eroded from the critical metering parts accumulates in the fuel system and is recovered and analyzed for radioactivity after each test.

A cross section of the nozzle housing, Fig. 4, indicates the lead shielding that must surround the radioactive nozzle. The assembly is designed to permit removal of the cover, installation of nozzles, and closure of the housing using long-handled tools.

Fuel pressure and temperature entering and leaving the nozzle can be adjusted to simulate any flight regime. Fuel is first pumped to high pressure and metered, then heated to the specified temperature. After passing through the nozzle, the fuel is cooled and returned to the fuel reservoir. The apparatus is suitable for fuel pressures to 500 psi, temperatures to 500 F, and nozzle discharge pressures to 200 psi.

The nozzle is heated by induction to simulate radiation from the combustor flame. In these tests, rates of about 125,000 Btu per sq ft per hr were used.

The temperature at which fuel was atomized was far above its flash point. Burning was avoided by pressurizing the spray chamber with nitrogen.

Although gum deposition can be serious when pumping JP-4 fuel at temperatures above 250 F, gum was minimized to the extent that one fuel charge could be used for periods of 50 hr. This was achieved by careful design of the system to keep oxygen from the fuel and to maintain good circulation throughout the high-pressure part.

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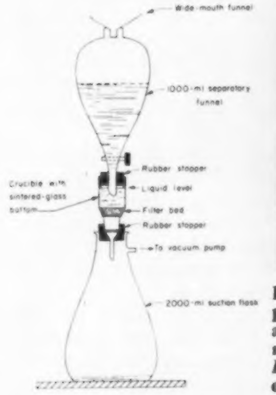
Fig. 5 The filtration apparatus. Important is the filter bed consisting of alternate layers of cation resin and activated charcoal.



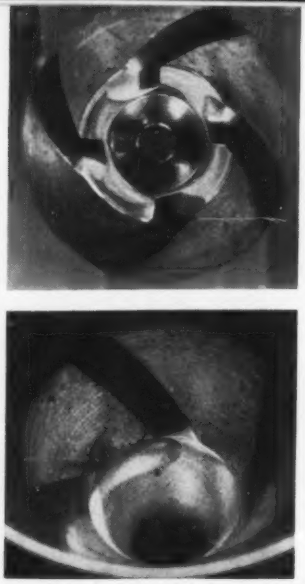


Fig. 6 Typical erosion. *Above,* pronounced wear is evident in and between the metering slots near center of nozzle distributor. *Below,* extensive pitting at the top edge of the conical swirl chamber.

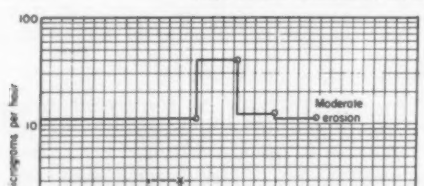


Fig. 7 Experimental data—relation of wear rate to operating time for three different fuel nozzles. Each nozzle was first operated overnight with cold fuel. With the introduction of hot fuel, erosion zoomed to a high rate: Then, over the hours, it settled back to a fairly constant lower rate.

Some gum and carbon were formed in every test, and radioactive material was often concentrated in gum deposits. A means of cleaning the system, using successive solvent and acid washes, permitted recovery of all radioactive material after each test.

Radiochemical Techniques

The metering parts, made of a stainless steel, were enclosed in a watertight aluminum capsule and suspended for 13 days at the face of the core of the Battelle nuclear reactor. The sensitivity of any radiochemical detection technique depends upon the level of radioactivity of the material being traced; that is, a highly radioactive material can be detected in smaller quantities than a less active material. Because of the small size of the nozzle parts, it was possible to use very high levels of radioactivity per unit weight and still contain the experimental nozzle safely in a lead-shielded housing.

Because of the extremely low erosion rates, the measurement accuracy required was several orders of magnitude greater than is customary in wear measurements. The metering sets in which erosion occurred are tiny precision parts much like those in a watch. They weigh only 3 grams, and the total wear in a 3-hr test may be of the order of 1 to 10 millionths of a gram—a fantastic amount to detect. However, such amounts were measured with accuracy of ± 0.3 microgram.

The infinitesimal amount of wear material was dispersed through about two quarts of fuel-and-solvent solution and a quart of acid solution. Fig. 5 shows the apparatus used to filter the fuel and wash samples. After each filtration, the filter-bed material is dried, mixed, and placed in a scintillation counter for analysis. This instrument counts the disintegrations per minute, which are proportional to the weight of radioactive material.

Since the filter could not remove all the radioactive material, especially from the acid sample, samples of the solutions were measured for radiation rate, and the total radioactive material computed by the ratio of volumes.

Parameters for Design

Using these techniques, nozzle configurations have been investigated to establish design parameters relating erosion to geometry and operating conditions. In exploring various designs, instances of both mild and severe erosion were encountered. Fig. 6 shows examples of erosion in nozzle distributors and in conical swirl chambers.

The techniques provided consistent and reliable data in over 100 comparisons. Measured wear rates appeared to be in reasonable agreement with those determined in actual engines. However, in both laboratory and engine tests, large differences in erosion are observed for the same nozzle design. This is probably the result of small variations in nozzle construction or in test conditions.

Experimental data illustrating mild to moderate erosion are shown in Fig. 7. The erosion rate, on a logarithmic scale, is plotted against operating time. The sharp rise occurring at the twentieth to thirtieth hours results from the introduction of hot fuel, after an overnight break-in period with cold fuel. During subsequent periods at high temperature, the erosion rate drops to lower levels and remains fairly constant.

Many wear measurements have been based on the use of radioactive wear parts, but the techniques used here extended the application by measuring wear rates much smaller than would usually be considered. This was a case where any type of test would be difficult. The fact that consistent and useful data were obtained should encourage use of such techniques.

Acknowledgment

The authors wish to thank the Delavan Manufacturing Company for permission to publish this paper, and to acknowledge the valuable contributions of the following men: Ralph I. Mitchell, who took part in the development of the technique and apparatus; Meyer Pobereskin, who contributed much to the development of the radiochemical techniques; and Walter Braun, who conducted the nozzle irradiations and radiochemical analyses, all of Battelle Memorial Institute. Mr. H. F. Rothwell, of the Delavan Manufacturing Company, and Mr. E. Vernon Jaramillo, formerly of Delavan, contributed much to the planning of the research.

CONTROL OF A JOB-SHOP MACHINE FLOOR

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Integrated electronic-data-processing equipment makes possible faster, more accurate data processing, with a degree of system integration and depth of analysis heretofore impractical for the control of manufacturing in a medium-sized plant

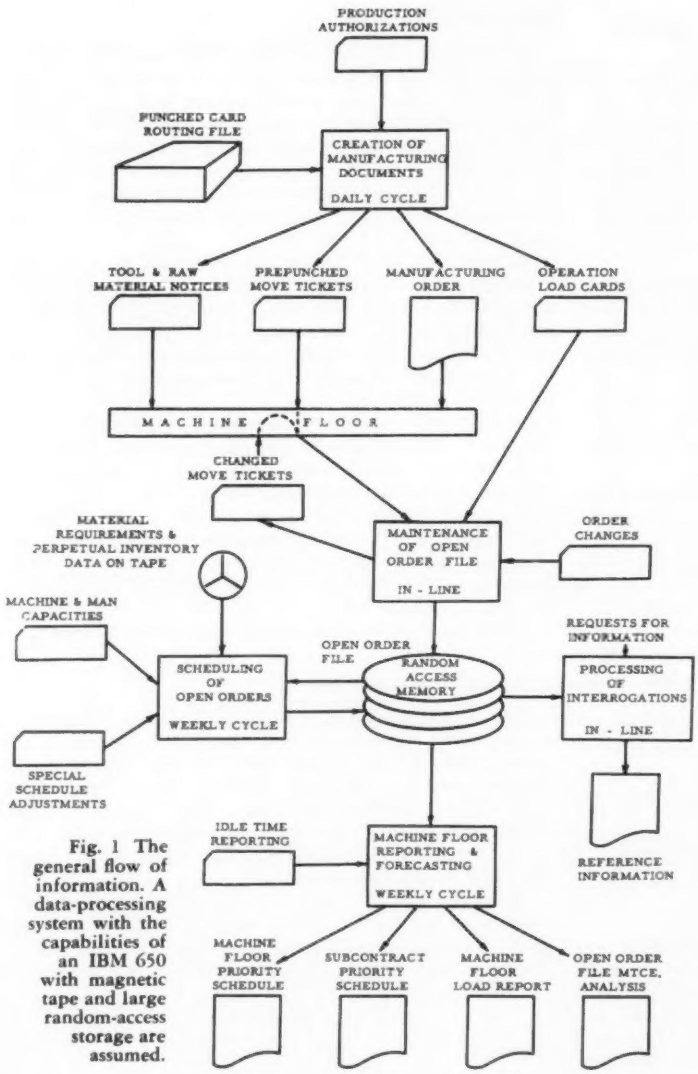

Fig. 1 The general flow of information. A data-processing system with the capabilities of an IBM 650 with magnetic tape and large random-access storage are assumed.

One of the most important and most difficult aspects of production management is the maintenance of a smooth, efficient flow of work through the production departments consistent with minimum inventory and physical-plant considerations. In the face of varying delivery schedules, product specifications, inventory policies, and personnel and machine availability, this can quickly become a Herculean task. In striving for the greatest efficiency of operation, production management is dependent upon some kind of data-processing system for prompt and accurate control of the day-to-day manufacturing operations within an established policy framework. In order to review and appraise the effectiveness of this policy, and take the necessary corrective action, management also must be provided with up-to-the-minute reports which accurately describe and analyze historical data, and also reliably predict future operations A proposed approach to the problem with emphasis on the job-shop form of manufacturing will be presented.

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Objectives and System-Design Philosophy

The need, as seen from the machine-floor control aspect, can be more specifically stated by the following objectives: (*a*) "In-line"[1] maintenance of control data for all manufacturing orders, including in-line creation of new orders, changes to existing orders, and status updating; (*b*) up-to-date scheduling and loading of all open manufacturing orders to reflect the latest product-delivery schedules and engineering changes, the most recent stock status, and the expected capacity limitations; (*c*) prompt

[1] Literally speaking, in-line refers to the processing of input documents in step with their arrival for processing. No accumulation of input data is allowed. It is contrasted with "batch" processing which describes the processing of accumulated input documents in batches.

reporting and effective analysis of historical data, including nonproductive time, work completed, work subcontracted, and new work released; (*d*) early forecasting of the highs and lows in the future work flow, with provision for providing detailed information where needed in taking corrective action; (*e*) accurate data processing in all phases of the system. Accuracy cannot be overemphasized, especially in the creation and handling of primary-source data.

The data-processing system, Fig. 1, was designed to approach these objectives. Orders are created on a daily cycle with no operation scheduling at this point. The undated orders themselves go to the starting departments while the operations on each order are entered into the Open Order File, which is in some form of large random-access memory. Order changes, status updating, and requests for information are handled in small, frequent batches, a step toward in-line maintenance.

Once a week all outstanding orders are scheduled operation by operation on the basis of: (*a*) Priorities determined by inventory and lead-time considerations; (*b*) the standard times for each operation; and (*c*) man and machine-capacity limitations. Although the method of scheduling is not very sophisticated, the up-to-date integration of these different factors provides a significant advance over conventional techniques. The resultant priority schedules, Table 2, list the preferred sequence of work expected to hit a given machine group in the current week.

Coincidental with the scheduling function, a Machine-Floor Load Report, Table 1, is prepared. One portion of the report includes historical data; another portion summarizes the scheduling detail with a forecast of the highs and lows in future work flow. An explanation of each field of data is furnished on a supplementary sheet.

Prerequisites

In order to realize the full effectiveness of a new portion of any data-processing system, it must be set down in an environment that meets similar standards of accuracy, depth, and timeliness. The following are considered prerequisites of the techniques to be described: (*a*) A Material-Requirements and Perpetual-Inventory system which will generate production-authorization notices with the proper timing and quantity specifications required to meet the product demand—the accuracy of these data will have a direct impact on the effectiveness of the shop scheduling; (*b*) a detailed routing for each part to be manufactured, including standard setup and running times for each operation; (*c*) a procedure for initiating changes in a routine following its release as a manufacturing order, such as changes in machine-group assignments, added operations, send-aheads (split-offs), and subcontracted operations; (*d*) a system for reporting the progress of each order through the specified steps of manufacture; (*e*) a system for reporting nonproductive machine time and the reasons for it; (*f*) a means for periodically measuring machine-group and departmental efficiencies.

The data-processing capabilities of such electronic equipment as the IBM 650 with magnetic tape and large random-access storage will be assumed. With appropriate data-system modifications other combinations of machines could be used.

Data-Processing System

The main flow of information is diagrammed in Fig. 1. A Production-Authorization card initiates action and, together with a manually pulled routing deck, is processed through conventional punched-card equipment to produce the printed description of the manufacturing sequence, the prepunched move tickets (one for each operation), and the raw-material and tool notices. These documents are sent to the proper departments on the machine floor.

An operation-load card is also prepared for each step in the manufacturing sequence and used to enter the order into the Open Order File which is stored in the random-access memory and updated as each operation is completed or changes are made in open orders. This file can be interrogated on an in-line basis, and the desired information printed out.

Once a week all orders in the file are rescheduled in accordance with the latest requirements spread, the inventory status, special expediting and stop-production notices, and capacity limitations.

These scheduled orders, as well as the work completed and nonproductive time reported since the last report, are then used in developing the Load Report and Priority Schedules. An analysis is also prepared of the effect on the outstanding work load of all new orders released and changes made to existing orders since the last report.

Machine-Floor Load Report

The Machine-Floor Load Report, Table 1, may be conveniently pictured in three sections: Heading; historical data for the period from the last report to the present; and forecast data. The historical data encompass the Nonproductive Time, Work Completed, and Subcontract lines. The forecast section includes Load as Scheduled to Inventory, Load as Scheduled to Capacity, and the various ratios.

In addition to the machine-group-level reports, summaries are provided at the department, project-manager, and over-all machine-floor levels. In these instances, the heading lines include data on man capacity as well as on machine capacity.

Forecast

In compiling the Load as Scheduled to Inventory portion of the Machine-Floor Load Report, the *desired* stock date for each order is determined by: (*a*) The latest material-requirements schedule, which incorporates changes in the machine-delivery schedules and the bills of material; (*b*) the latest inventory position and inventory policies; and (*c*) the relative status of orders for the same part. The individual operation-start dates on each order are determined by reverse scheduling from the *desired* stock date using: (*a*) Order quantity; (*b*) the sequence of operations; and (*c*) the standard setup, run, and move times for each operation. Any order that is judged excessively ahead or behind schedule is tagged for individual investigation. This form of scheduling is dominated by the inventory-management policies.

In distributing the work load represented by each operation across the forecast, the scheduled start date of the operation, the standard-load hours of the operation, the number of shifts worked by the department, and the calendar of shop working days are all considered. The units are standard hours.

Table 1 Machine-Floor Load Report

001 0129[a] Gridley 4SP screw machine $2^1/_4$[b] Machine capacity 5[c] 72% 288[c] 09/30/57,[d] 10/07/57,[d] 12/27/57[d]

HISTORICAL		Total hours	No operator	No work available	Machine breakdown	Tool trouble	Other idle time	Setup time	Resetup time
Nonproductive time[g]	1st shift	33	15	7	1	1	3	5	1
	2nd shift	48	27	11	6		2	2	
	Totals	81	42	18	7	1	5	7	1

	Total	Behind schedule	On schedule	1–3 weeks ahead	Over 3 weeks ahead
Work completed	10[e] 220[f]	5[e] 114[f]	3[e] 73[f]	1[e] 20[f]	1[e] 13[f]

	Planned	Out to vendor	Outstanding	In receiving inspection	Accepted
Subcontracted load	1[e] 15[f]		8[e] 101[f]	1[e] 14[f]	

FORECAST	Behind schedule	Current week	2nd week	3rd week	4th week	5th–6th weeks	7th–8th weeks	9th–12th weeks	Balance	Total hours
Load as scheduled to inventory[h]	110	293	271	268	235	403	314	735	125	2754
Scheduled-to-inventory load/capacity ratio	0.4	1.0	1.2[j]	0.9	0.8	0.7	0.5	0.6	0.4	9.6
Limit of load/capacity ratio	0.0	0.8	1.0	1.0	1.0	0.9	0.6	0.6		
Load as scheduled to capacity[h]										
Available to run		180	101	48	13	3				345
Coming in—in the plant		79	78	141	239	507	347	701	189	2281
Coming in—now on subcontract		18	53	46	11					128
Total scheduled-to-capacity load		277	232	235	263	510	347	701	189	2754
Scheduled to capacity load/capacity ratio		0.8[i]	1.0[j]	0.8[k]	0.9[k]	0.9	0.6	0.6	0.7	9.6

[a] Department and machine-group identification.
[b] Type of machine.
[c] The first figure is the number of machines, the second is the Measure of Efficiency, the third is Base Capacity.
[d] Reference dates: First, beginning of historical period, then date of report, and end of forecast period.
[e] Number of operations.
[f] Number of standard hours for these operations.
[g] Expressed in actual hours.
[h] Expressed in standard hours.
[i] Capacity of current week arbitrarily assumed 20 per cent higher than shown to cover partial completion of in-process work.
[j] The second week happens to have only four working days.
[k] Schedule interference and/or manpower shortage happens to interfere with loading to limit of machine capacity.

Table 2 Machine-Floor Priority Schedule

Department	Group	Part no.	Job	Quantity	Operation	Operation start date	Days off schedule	Stock date	Operation load hours	Hours scheduled in week	Present location	
001	0129	0325481[a]	1300	030000	0035	071	5P[a]	101	13.3	13.3	001	0129
		1287254	4301	000100	0100	052	15—	061	45.1	45.1	001	0129
		0138100	0500	005000	0020	055	12—	090	23.0	23.0	081	2262
		0152634	3100	002200	4060	060	4—	084	23.9	23.9	001	0129
		1285932	8131	150000	0033	063	6—	069	18.1	18.1	S/C[b]	
		5143870[c]	6905	011000	7085	064		077	17.9	17.9	001	0129
		3001497	1000	002000	7040	067	1—	078	14.2	14.2	031	1042
		5143870[c]	6905	011000	0090	068		120	25.7	25.7	001	0129
		0187694	0300	056000	0035	070	4	089	32.0	32.0	001	0129
		0302319[d]	1000	000820	0040	070	3	082	71.1[d]	48.0[d]	001	0129
		0508471[e]	5100	000550	0010	071		141	23.7[e]	16.0[e]	631	

[a] This part has special priority, indicated by P, and heads the list although it is ahead of schedule.
[b] Denotes presently subcontracted orders.
[c] Only the first of two successive operations scheduled into this machine group for the current week is classified as "available to run" in the Load Report.
[d] Only 48.0 of 71.1 hr are contributed, since the operation is scheduled to overlap the first and second weeks.
[e] Only 16.0 of 23.7 hr are contributed since machine capacity is exceeded.
The remaining hours for *d* and *e* will have first priority on the available capacity of the second week.
The high order digit of operation has special meaning and is not a factor in operation sequence.

The Scheduled to Inventory Load/Capacity ratio is calculated by dividing the scheduled load hours for each period by the anticipated capacity for the period. The capacity is the base capacity shown in the heading, adjusted as necessary for the length of the period.

Up to this point no capacity limitations have been considered. The Limit of Load/Capacity ratio represents a statement of those limitations by production management. When compared with the ratios in the Scheduled to Inventory Load/Capacity, the extent of overloading and underloading and their locations in time can be quickly spotted.

To determine the expected interaction of the orders on the machine floor and reschedule accordingly, the relative priority of all orders must first be determined. The prime basis for this determination is the Scheduled-to-Inventory start date of the *active* operation on each order, although this may be overruled by "expedite," "stop production," or other schedule-adjustment notices from management. Thus, in general, the most severely

behind-schedule orders top the priority list and the ahead-of-schedule orders have the lowest priority.

Orders are scheduled to capacity in priority sequence, with the work load of each operation being distributed in accordance with the same parameters recognized in the Load-as-Scheduled-to-Inventory distribution, *plus* machine and man-capacity limitations. Whenever either man or machine capacity is exceeded, an operation with lower priority would be rescheduled into the future, as necessary, until an underloaded period is found in that particular department and machine group.

The present location of the order determines whether the operation is shown as available to run, coming in but now at a preceding operation in the plant, or coming in but now at a preceding operation which has been subcontracted. All figures represent standard hours.

The total standard hours for each period are related to the anticipated capacity available in that period to give the Scheduled to Capacity Load/Capacity ratio. This is "good" but not "optimum" scheduling. More sophisticated but more expensive techniques involve better priority determination and the simultaneous juggling of all orders and the capacity parameters in order to work out the best solution. These evolutionary, rather than revolutionary, scheduling techniques can be altered without invalidating the general framework of shop control. Optimum scheduling will naturally receive more attention as the accuracy and utility of the over-all production-control system improves.

Priority Schedules

The Machine-Floor Priority Schedule, Table 2, lists the priorities of work expected in the specified machine group within the current week. Each department dispatcher receives such a listing for each machine group within his department.

The listing shown in Table 2 is illustrative of several different scheduling effects, as indicated in the table notes.

The Subcontract Priority Schedule is a similar report arranged in vendor sequence which is used by the expediters in controlling subcontracted work.

Using the Load Report

As mentioned earlier, one of the objectives of this data-processing system is the prompt reporting and effective analysis of historical data. The upper half of the Load Report attempts to do this.

The analysis of Nonproductive Time indicates weak spots in the shop operation, and shows where increased utilization efforts are most likely to bear fruit.

The Work Completed line measures the performance of the shop in terms of standard hours, pinpoints departments where excessive ahead-of-schedule work is being done to the detriment of a backlog of behind-schedule work, and permits tighter shop control or opens up new avenues of inventory policy and scheduling sophistication.

The Subcontract line shows the magnitude and present location of this work load.

Another objective of the system—the early forecasting of the highs and lows in the future work flow—is the aim of the lower half of the report. These data enable management to plan with confidence broad or spot adjustments in the subcontract program, in machine purchase or disposition, in manpower shifts, in overtime commitments, in future production goals and delivery schedules, in inventory policies, and so forth.

The detail behind any figure in the report can be obtained on request.

It should be made clear that the Load as Scheduled to Inventory is based on the philosophy of order scheduling through inventory management, while the Load as Scheduled to Capacity subjugates (but does not disregard) this to the philosophy of order scheduling through manufacturing management. By comparing these two load pictures, management can see what corrective action is needed to bring them closer together. In most cases, a compromise between inventory management and efficient factory operation must be achieved.

Attempts to prepare a *single* shop-load forecast have been unrewarding since by their very nature they tend to obscure the basic effects at work in the plant. In the load report described by this paper, the intention has been to prepare and publish a load forecast based solely on inventory-management goals, and then to bring into the picture the effect caused by capacity limitations. The only schedules to reach the shop floor are related to the latter, more comprehensive analysis, but plant management is furnished with both load forecasts so that the degree and location of the differences between the two points of view can be observed.

Since the Requirements, Perpetual-Inventory, Scheduling, and Load-Reporting functions are tied together as an integrated system without any necessary human links, it is possible to *simulate* policy or other changes in any portion of the system and observe the resulting effect on the simulated machine floor without interfering with normal operations.

Another worth-while use of the Load-Report data comes from comparing it with corresponding data from preceding reports. Columnar and graphical presentations of this sort can be prepared by the machine system without difficulty.

Summary

With the advent of integrated electronic-data-processing equipment, faster, more accurate data processing is possible with a degree of system integration and depth of analysis heretofore impractical. This paper has described a proposed data-processing system designed to handle the record keeping, scheduling, and load reporting for a job-shop type of manufacturing in a medium-sized plant. The system provides for in-line file maintenance and for periodic rescheduling of all open orders on the basis of the latest material requirements, inventory status, and shop capacity. The resulting machine floor and subcontract-priority schedules control day-to-day operations, while the machine floor load report analyzes the past operation and forecasts the future operation of the shop.

Acknowledgments

The author is indebted to D. N. Hannum, I. D. Love, R. P. Muller, J. I. Norden, and D. G. Zurflieh of the International Business Machines Corporation for the variety of background experience which they contributed to the development of this concept of job-shop control.

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AUTOMATIC INSPECTION

Automatic preprocess, in-process, and postprocess gaging builds precision and higher production into the modern machine tool. Signals from gages insure quality, effect savings.

For controlling quality in production, automatic inspection devices are coming in. This is true not only in the metal-cutting field but in the manufacture of plastics, glass, ceramics, and rubber. In machine tools, with their new accuracy and speed, automatic gaging and control devices result in higher capability.

Such devices generally fall into one of two categories—"in-process," or "postprocess" systems. The actual gaging medium may utilize a pneumatic, electric, or electronic system, or a combination of these systems.

By popular demand, the pneumatic system is widely used because of its accuracy, dependability, simplicity, and ease of maintenance. Such a system is shown schematically in Fig. 1.

In-Process Control

One of the simpler and most commonly used in-process grinding-machine controls is the caliper-type gage shown in Fig. 2. Normally, the caliper is manually engaged with the workpiece after the grinding cycle has been started. As the workpiece diminishes in size, an air jet is actuated, and through an air-gage head electrical signals are produced. A common usage of the resulting signals are:

1 Upon reaching a predetermined dimension prior to final size, a contact is made, causing a slower rate of infeed of the grinding wheel.

2 When finished size of the workpiece is reached, a second set of contacts is closed, causing immediate retraction of the wheel slide.

Largely because of the problem created by curling chips and minimum tool clearance, in-process machine controls are not as widely used in turning as in grinding operations, even though the required precision of the part would make it desirable. In such cases, postprocess gaging is often the answer. Because postprocess controls are more widely used, the applications are consequently more varied.

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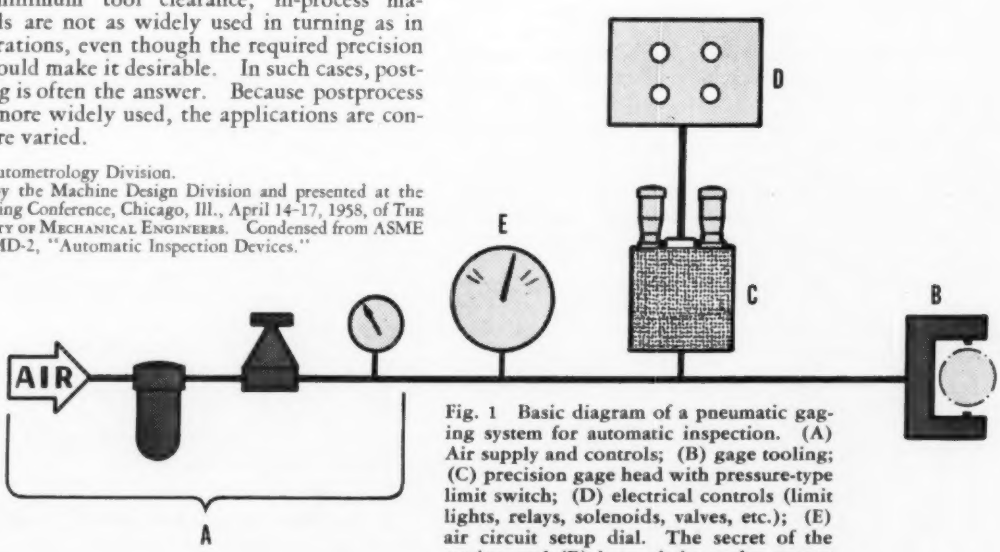

Fig. 1 Basic diagram of a pneumatic gaging system for automatic inspection. (A) Air supply and controls; (B) gage tooling; (C) precision gage head with pressure-type limit switch; (D) electrical controls (limit lights, relays, solenoids, valves, etc.); (E) air circuit setup dial. The secret of the gaging tool (B) is an air jet at the contact point. The back pressure in the line becomes a measure of the clearance between gage and work.

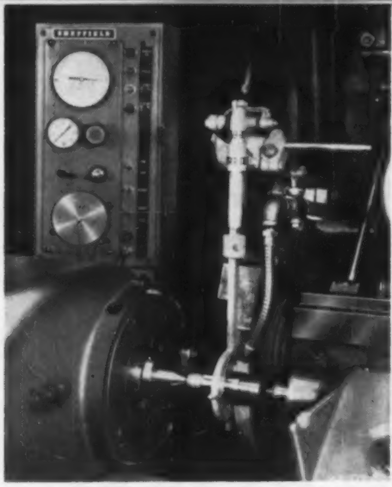

Fig. 2 Caliper-type gage commonly used with "in-process" grinding machine controls. The varying back pressure of the jet at the air gage head produces electrical signals. Wear life of the gaging tool in a pneumatic system is generally greater than other systems employing only contact-type gages, owing to the inherent clearance of the pneumatic gaging tool and the part being inspected. By reversal of this caliper-type contacting member, a similar arrangement is used to control the grinding of inside diameters.

Fig. 3 A "postprocess" gage for a single dimension. A gage of this type invariably incorporates a "demand circuit" or presence-of-part switch to initiate the gaging cycle. When a part leaves the machine tool, it closes the switch, and the gage then goes through a complete automatic cycle.

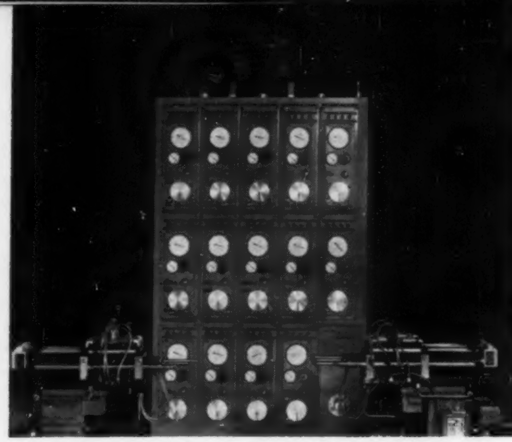

Fig. 4 A complex "postprocess" gaging and control unit. This "modular" unit gages 13 separate dimensional characteristics, houses pneumatic and electronic controls for a boring machine. Both here and in the simpler device of Fig. 3, the module produces the signals necessary for control of the machine tool producing the part.

AUTOMATIC INSPECTION

Postprocess Control

Some of the simpler postprocess controls may gage and control a single dimension such as a bore diameter, an outside diameter, or a cut-off length from a more or less standard machine tool. Such a simple gage is shown in Fig. 3.

Once a part has been ejected from the machine tool, it is directed to the gaging station. Here, after closing of the presence-of-part switch, the control device will go through its own complete automatic cycle. If the particular machine tool being controlled is equipped with grinding wheel or tool slide in-feed devices, the use of the gage signals is wider and more advantageously applied. Thus, with a machine so equipped, a signal can be chosen to readjust or change the tool when a precise physical dimension is reached.

If, however, "inching" or feeding devices are not integral with the machine tool, a very desirable use of the gage signals from a cost-saving and quality-control viewpoint is as follows:

1 Light minimum warning light when minimum tolerance is approached.

2 Light maximum warning light when maximum tolerance is approached.

3 Stop machine when minimum tolerance is reached.

4 Stop machine when maximum tolerance is reached.

In items 3 and 4 the machine is normally not stopped until a predetermined, consecutive number of out-of-tolerance parts has been produced. Provisions usually are made, however, to eject all out-of-tolerance parts from the flow of good parts to the next operation.

Multiple Dimension Control

The simple control as shown in Fig. 3, designed to gage a single dimension, can be expanded, as the occasion demands, merely by designing the gaging tooling to meet the gaging requirements of two or more dimensions or conditions and combining "modular" control units. The combination of these modules and the necessary tooling is shown in Fig. 4. This particular device gages and controls a boring machine, producing 13 separate dimensional characteristics at one time.

The Complex Operation

The foregoing examples are typical of inspection units applied to standard and semistandard machine tools. When the production requirements involve special transfer or index types of machines, the gaging controls may become rather complex.

For a machine that bores the 16 valve-tappet holes in an automotive cylinder block, the postprocess gaging has to control not only the size of the bore but conditions such as roundness and taper as well. To meet these requirements, the sequencing mechanism of the gaging unit may function as follows:

1 Locate and clamp part.

2 Insert gaging members into the mouths of the bores, where a true diameter is checked.

3 Rotate gaging members 360 deg to check roundness.

4 Progress gaging members to bottom of bores to check taper.

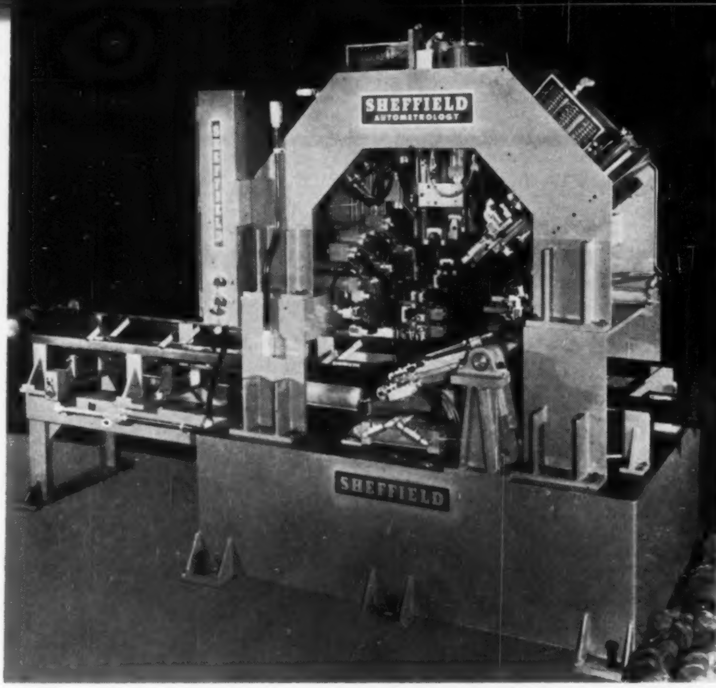

Fig. 5 This "preprocess" gage checks the minimum-maximum metal conditions of an automotive crankshaft prior to machining to prevent tool damage from excessive stock and to eliminate cost of machining oversize forgings. Not only are the machine tools provided maximum protection, but costs are reduced by the elimination of costly machining and grinding on forgings that will not meet minimum metal requirements.

Fig. 6 The Monitorecord, a sequence time recorder, provides means for checking and precisely timing modern high-speed production equipment. The recorder can be wired temporarily into the electrical control panel, or the machine may be equipped with a special receptacle for the instrument.

5 Rotate gaging members again to check roundness in a second plane.

During the foregoing sequence, should any one bore be found to be beyond tolerance on any of the required limits, the part will be correspondingly marked, ejected, or the machine cycle stopped until corrections are made.

Here again, it is common practice not to stop the machine on detecting the first faulty part but to count a predetermined number before such a shutdown is effected. This, of course, prevents excessive down time of the machine for correction which may not be a machine error at all but due to a faulty casting or improper part clamping.

A further refinement on automatic gaging and control devices often calls for a combination of an in-process and a postprocess gaging device, working as a control team. The in-process gage is subject to more drift due mainly to dirt and grit, coolants and temperature changes caused by variation of stock removal. Therefore it is often desirable to have a postprocess gage not too remotely located from the machine to actually control and "zero" or adjust the in-process device. This provides for the possibility of cleansing the part and allowing for temperature normalizing. In this manner, the secondary or postprocess device more nearly approaches a final inspection gage.

Preprocess Control

Gaging controls not only provide the quality required in the end product, plus cost savings through reduced scrap and through higher machine-tool utilization; they often are applied in advance to protect tooling—or the machine tool itself—in machining operations. Preprocess gaging determines that the raw stock, casting or forging, does not have a surplus of stock which might cause damage.

Fig. 5 shows a preprocess gage. The part involved here is an automotive crankshaft forging. All of the minimum-maximum metal conditions are checked prior to any major machining.

The Time Element

The use of such controls and machine tools, standard and special, requires precision timing and synchronization to obtain the maximum performance. The "Monitorecord" (Fig. 6) is a sequence time recorder designed to receive up to 14 electrical impulses from the machine and record the duration of each on a pressure-sensitive paper. Thus a visual chart is produced that will indicate closing of limit switches, relays, timers, and solenoid valves that in turn may control clamping, slide movements, part transfers, and the like. The resulting paper chart is then compared to a permanent plastic coded chart which had been prepared when the equipment was new and operating at peak efficiency. Its periodic use as a preventive maintenance device allows readjustments to provide higher operating efficiency and less down time.

The cost savings effected by the installation of automatic inspection devices applied to machine tools are appreciated not only by the manufacturer of the end product but by the machine-tool builder. Many builders of modern machine tools are incorporating gages and controls as standard or optional equipment.

OPERATING A RESEARCH REACTOR

By Jerome L. Shapiro and Henry J. Gomberg
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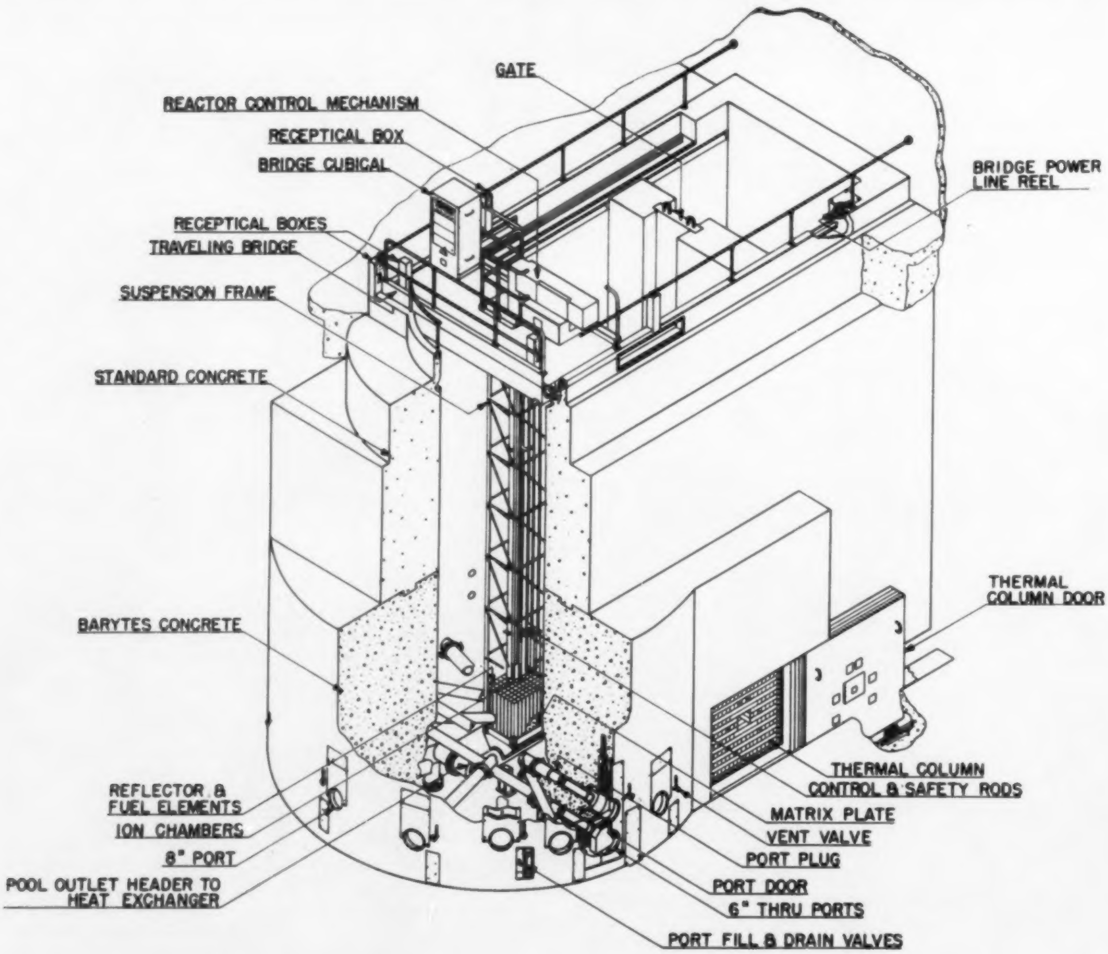

Fig. 1 *above,* The Ford Nuclear Reactor is a swimming-pool-type research reactor designed as a gamma-radiation source and for training and research in reactor physics and engineering

Fig. 2 *right,* The heat exchanger, the long horizontal cylinder at the *lower right,* and much of the rest of the water-handling system are located in the basement of the laboratory building

Although the Ford Nuclear Reactor has operated extremely well and has required no major changes or repairs since start-up, there were prestart difficulties with safety-rod alignment, pool-water leakage, and rust in the water-handling system. Reactor calibration experiments and some irradiation of materials have been the principle operating experience to date.

THE Ford Nuclear Reactor, located at the University of Michigan, in Ann Arbor, was designed and partially fabricated by The Babcock & Wilcox Company. Construction was begun early in 1955, criticality was achieved in September, 1957, and the reactor has been in operation since. Some of the operational and preoperational experience should be of interest to designers and potential operators of research reactors.

The Michigan Memorial-Phoenix Project, under whose auspices the reactor was built, is a university-wide unclassified program of study of the peaceful uses of atomic energy supported by gifts from alumni and others. Areas in which research is under way include medicine, chemistry, physics, engineering, geology, archeology, law, and the social sciences.

The Ford Nuclear Reactor, one of seven campus laboratories equipped for atomic research by the Phoenix Project, was made possible by a gift of $1 million from the Ford Motor Company fund. In the course of this work, the University became a pioneer in the construction of an atomic-energy facility *outside* the auspices of the United States Atomic Energy Commission.

Reactor Description

The Ford Nuclear Reactor was designed for several purposes: As a neutron and gamma-radiation source, an instrument for research in reactor physics and engineering, and as a nuclear-engineering training reactor. With these applications in mind, a high-power reactor was built which is flexible in operation and has many access ports.

The reactor is of the swimming-pool type, and is a heterogeneous, light-water-moderated, highly enriched fuel assembly submerged in a tile-lined 40,000-gal concrete tank. The MTR-type fuel elements are constructed of 18 3-in-wide, 0.060-in-thick, and 25-in-long curved plates brazed into two side plates to form a box about 3 × 3 × 25 in. Each plate is a sandwich of aluminum surrounding a uranium-aluminum alloy. The uranium is enriched to about 90 per cent U-235.

The fuel boxes, or elements, can be loaded individually in any pattern desired, onto an aluminum grid plate having 80 positions. The grid plate is located about 22 ft under water and is suspended from a movable bridge. The water acts as a neutron moderator and reflector without which the neutron chain reaction could not be self-sustaining. It also serves as a neutron and gamma-ray shield and as a viewing window as well as a reactor coolant.

In the course of circulation through the primary system, a 1000-gal delay tank is used to allow decay of much of the short-lived radioactivity, mainly N-16, before the water is returned to the pool. A mixed-bed ion exchanger with 25-gpm circulation is used to further insure sufficient purity of the water to provide low levels of radioactivity, reduce possibility of corrosion, and permit high visibility through the water. A cooling tower and ordinary city water are used in the secondary-coolant circuit for the tube side of the heat exchanger, Fig. 2.

The reactor operates at power levels up to one megawatt (heat) when the cooling system is used and is limited to 100 kw without cooling.

Operation of the Reactor

The movable bridge from which the reactor core is suspended allows operation in either of two positions, and storage in a third. In one position, where it is

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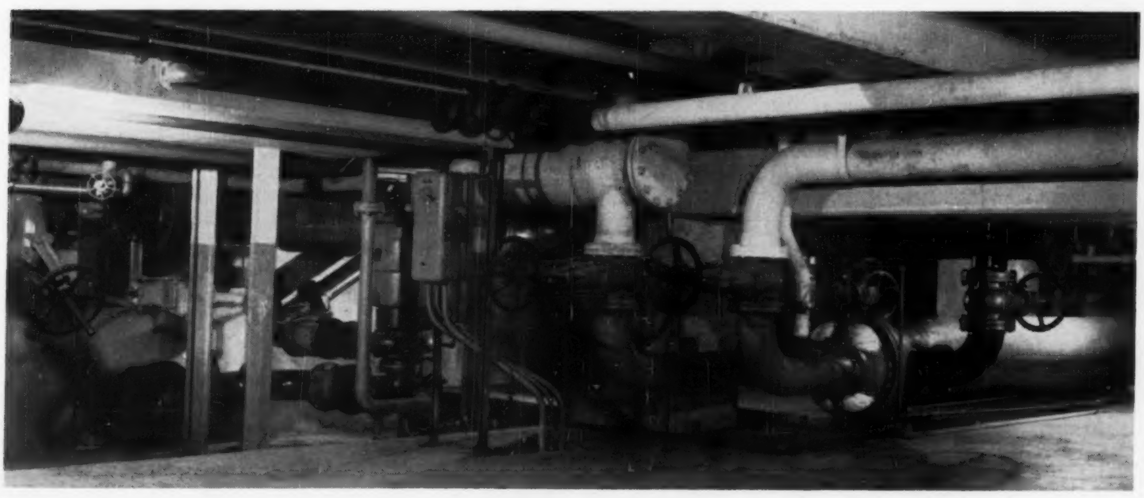
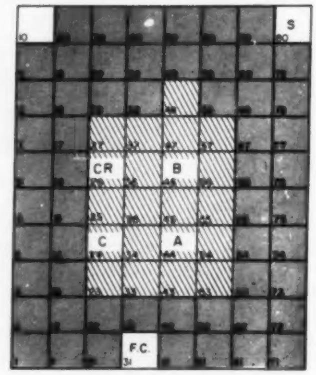


OPERATING
A RESEARCH REACTOR

Fig. 3 *left*, Diagram of the lattice configuration 1 *a;* Loading, 2539 grams, critical mass, 2497 ± 5 grams; *A, B,* and *C* are safety shim rods (5 plate elements); *CR* is a 5-plate-element control rod; *S* is a Po-Be source; *FC* is a fission chamber; light hatching indicates fuel elements; and darker hatching indicates graphite elements

Fig. 4 *center*, Plot of the average void coefficient as a function of the fraction of core water expelled; the void is distributed uniformly in the vertical direction and proportional to power in the horizontal direction

Fig. 5 *right*, Plot of temperatures at selected points versus time while cooling the pool during measurement of the temperature coefficient



LOADING Ia

directly over the cooling-water header, it can be operated at full power, and ten beam ports and four pneumatic-tube ports, which permit small samples to be very rapidly shunted in and out of the neutron field, are activated. In the other position, where the power level is limited to 100 kw in the absence of forced cooling, two beam ports are provided on one side and a thermal column on the other. The thermal column is a 6-ft-on-a-side mass of high-purity graphite which extends 8 ft through the concrete shield and allows experimentation with beams of thermal neutrons.

In the storage position, a portion of the pool can be sealed off, allowing maintenance to be done on the pool with the reactor core out of the way and well shielded. A transfer lock in the wall of this pool allows highly radioactive materials to be dropped into a hot cell in the adjacent building without removing them from the pool.

The reactor is controlled by four neutron-absorbing rods which fit into special fuel elements and can be raised out of the core. Three safety rods containing boron carbide, held to the raising mechanism only by electromagnets, drop and shut down the reactor if the current fails or drops below the minimum holding value. The fourth rod, made of stainless steel, is a regulating rod controlled from a switch on the console or from a servo system designed to hold a constant power level.

Five monitoring instruments supply power information through five separate electronic channels. Two ion chambers produce currents proportional to the power level and control safety-rod drop through an amplifier by causing the current to the electromagnets to fall below the holding level. The rods then drop and shut down the reactor whenever the power level reaches 150 per cent of the rated value, or whenever the reactor period is less than 5 sec. Information on the rate of change of power level is derived from the third ion chamber via a logarithmic amplifier and logarithmic-recorder display. A fourth chamber provides power-level information in linear fashion. This information is part of the control-rod servo system.

These four channels all work from d-c current proportional to the power level. In contrast, the fifth is a pulse-type chamber producing a short pulse of current every time a neutron is detected, and feeding these pulses to a count-rate circuit and to a scaler. Although the type of information is the same as that from the others, it can be used at much lower power levels. All five chambers originally required continuous gas flow, but replacements will not.

Prestart

One of the first problems which occurred prior to the start-up of the reactor concerned the alignment of the safety-rod drives. The dimensions of the magnet and armature guide rings were too close to those of the guide tubes through which they traveled, causing the armature to scrape as the rod drives were raised and the magnets to stick when they were being lowered. Turning down the OD of the guide rings eliminated the trouble.

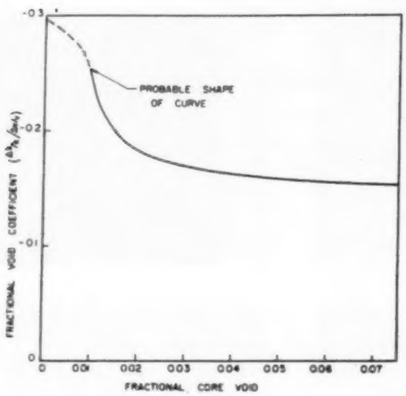
Rotation of the armature caused undesirable variations in the minimum holding current until the design was modified to allow the armature to be rotated and locked in the position giving the lowest holding current.

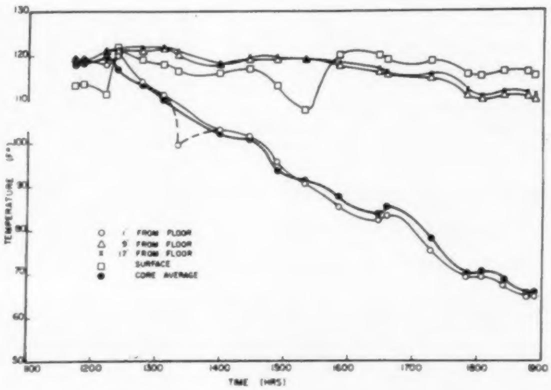
Although these modifications allow satisfactory operation of the safety rods, the characteristics of the magnet and its armature and of the rods themselves are still somewhat unsatisfactory. Time lags caused by the lightness of the rods and the magnet-armature characteristics are as much as 200 millisec, but these can probably be reduced, and investigations are under way.

Water Leakage. As water was first introduced into the tank, many cracks began to appear, leaking water through the $6^1/_2$-in-thick high-density concrete, mainly around the beam ports where poor bonding between the aluminum, the sealants, and the concrete had occurred, and at sharp corners where high stress concentrations exist. A volcanic-ash-bearing clay called Bentonite, pumped into the cracks under high pressure, has successfully sealed the leaks to date. There has been little past experience in designing a large concrete tank to have essentially zero leakage, and poor design of the foundation, leading to uneven settling, was the probable cause. Uneven pressure on the foundation as the pool is emptied and refilled may cause new cracks to develop which will be sealed as they occur.

Water System Rust. To correct for rust which developed in the ordinary steel piping of the primary system, sandblasting, flanging of the all-welded piping, and lining with $^1/_4$-in-thick hard rubber were employed. Most of this lining was done at the factory, but some sections which were embedded in concrete were lined in place and the rubber was steam-cured overnight. Samples of this lining had been tested previously in a Co-60 gamma facility where they were exposed to about 24 megarep without showing any physical deterioration.

No difficulties with water purity have been observed, nor has there been any problem of leakage at the flanged joints which replace the original welded connections.





Calibration

The initial calibration of the reactor was done using the core configuration shown in Fig. 3. This calibration included: (*a*) Measurement of flux and power distribution in the core, (*b*) control and safety-rod calibration, (*c*) measurement of the temperature coefficient of reactivity, (*d*) measurement of the void coefficient of reactivity, (*e*) determination of gamma-radiation level in the water, (*f*) reactivity effects due to flooding of beam ports, (*g*) effect on reactivity of moving the bridge to position *B*, (*h*) temperature measurements at 100 kw with convection cooling.

The detailed results of this calibration are presently being published. However, some general observations made in the course of this work are of interest:

1 At present, all the core configurations attempted have been surrounded on four sides by graphite reflectors. Under these circumstances, substituting a partial fuel element, consisting of five or nine fuel plates rather than the usual 18, for a reflector in a position on the outer edge of the core may add very little to or even reduce the reactivity. This is obviously due to the increase of neutron leakage into the water gap in the partial element, and little use has been found for these partial elements for this reason.

2 The void coefficient of reactivity is the change in reactivity per unit volume of void, or steam, formed in the core. This coefficient affects the response of the reactor to a transient power surge when boiling occurs. Rather than becoming increasingly negative for increasing percentage of the moderator removed, as calculations for a bare reactor indicate, the void coefficient becomes less negative rather sharply over the first 2 per cent voided and then rapidly approaches a constant, Fig. 4. More effort, both theoretical and experimental, is being made to determine the cause of this effect.

3 In order to measure the temperature coefficient, the pool was heated to about 110 F by passing steam through the secondary (tube) side of the heat exchanger. Then the reactor was started up and the effect on reactivity plotted as the water was cooled down by pumping cooling water through the heat exchanger. This also permitted examination of the stratification existing in the pool water.

In designing the primary-water return inlet to the pool, a diffuser plate was placed over it in the hope that this water, still containing some radioactivity, would remain close to the bottom. This stratification was observed by hanging the thermocouples at various heights in the pool while the water was being cooled. Fig. 5 shows the obvious lack of mixing.

Instructional Program

A laboratory course on nuclear engineering with experiments consisting of calibration work on the reactor as well as work with auxiliary instrumentation had an enrollment of 39 this spring. Another course for staff members and a group of reactor trainees, most of whom are under an International Cooperation Administration program, consists of lectures and operating experience. Those who satisfactorily complete the course can take an AEC examination for a license to operate the Ford Nuclear Reactor.

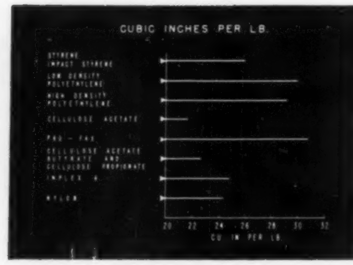
Irradiation

To date the reactor has been limited by the AEC to one megawatt-hr per week. This has been sufficient for the few, short irradiations which have been done mainly in the pneumatic tubes and by hanging samples next to the reactor from the top of the pool. However, it is expected that within a few weeks, longer operation at higher powers will be required. A fission plate is being designed and built by the Cook Electric Company for long, high-power irradiation of electronic components in the Ford Nuclear Reactor. It is expected that this will be done by placing a portable chamber adjacent to one face of the reactor.

One beam port has been allocated for an experiment on the effects of neutron and gamma radiations on some hydrocarbon reactions. The equipment has been built and will be placed in the port shortly.

Conclusion

In reciting the experience of the Ford Nuclear Reactor, the difficulties encountered have been stressed as an aid to others working on or contemplating similar projects. However, it must be stated, lest the wrong impression be given, that the reactor has operated extremely well and, since start-up, has required no major changes or repairs. Although the use of the reactor as a research tool is just beginning, it seems reasonable to conclude that the reactor will be as useful as the original planning indicated.

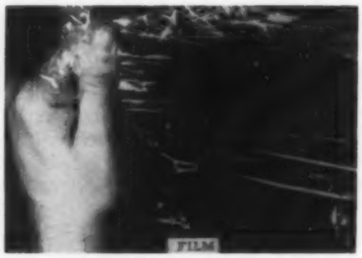


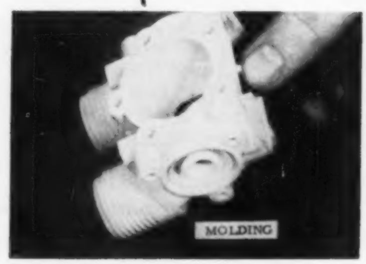
By E. W. Cronin

**Cellulose Products Department,
Hercules Powder Company,
Wilmington, Del.**

Properties and applications of isotactic polypropylene, a newly available plastic that can endure the heat of a sterilizing autoclave. As pipe, film, filament, or molded product, this is an important engineering material.

polypropylene
a new plastic





In 1953, at the Max Planck Institute in Mülheim, Germany, Karl Ziegler[1] discovered an atmospheric-pressure process for polymerization of ethylene to high molecular weight polymer.

This discovery, based on the use of special organometallic catalysts, has had a profound influence on polymer technology. It was soon observed that very similar organometallic catalysts were capable of converting alpha-olefins in general (propylene, butene-1, etc.) to high melting crystalline polymers. Such higher polyolefins had hitherto been obtainable from acid or free radical catalysis only as amorphous materials of relatively low softening point.

The crystalline alpha-olefin polymer which has received most attention up to the present time, is polypropylene.

Early commercialization of this product, as compared with other crystalline alpha-olefin polymers, was inevitable in view of the low cost and availability of propylene and the relative ease of polymerization using Ziegler type catalysts.

[1] Ziegler, Holzkamp, Breil, and Marten, *Angewandte Chemie*, vol. 67, 1955, pp. 426–521.

Based on a paper contributed by the Rubber and Plastics Division and presented at the Semi-Annual Meeting, Detroit, Mich., June 15–19, 1958, of The American Society of Mechanical Engineers.

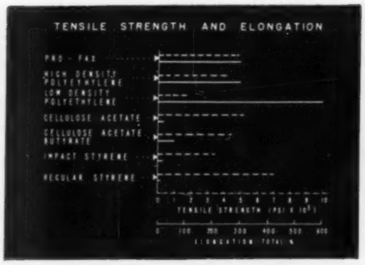
Polypropylene as a New Raw Material

Foremost in judging the importance of polypropylene as a new raw material is the price of the product plus future economic considerations in comparison with competitive materials. As production volume increases, it is expected that the selling price will approach that of polyethylene. With this potential price and with the increasing price of basic metals and costs of fabrication, a number of industries believe that by 1961 large items, such as refrigerators and dishwashers, will be more economically fabricated from plastics.

Polypropylene has been formed without difficulty into injection-molded parts, extruded shapes and pipe, extruded film and drawn sheet, and into monofilaments and multifilaments as illustrated in Fig. 1. It yields parts completely resistant to stress-cracking, of high gloss, and of excellent chemical resistance. From comparative data, it is apparent that a valuable new material is being offered to the engineer for fabrication of industrial items.

In volume per unit weight, polypropylene offers the most favorable ratio of any plastic material (Fig. 2). Thus any formed part will possess an extremely high strength-to-weight ratio.

In tensile strength and elongation (Fig. 3), polypropylene is adequate, and its utility and acceptance in general plastics use are assured.



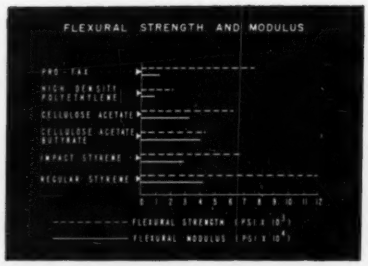
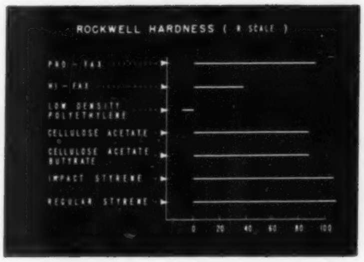
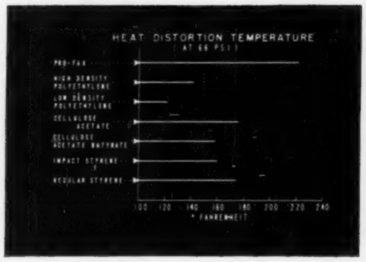


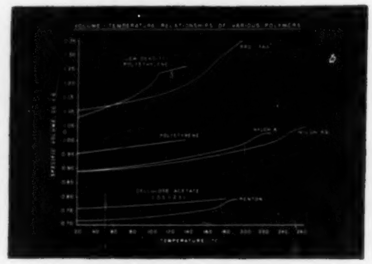
Fig. 2 Volume per unit weight of several plastic materials. "Pro-fax," Hercules' polypropylene, shows the most favorable ratio of any plastic.

Fig. 3 Tensile strength and elongation comparisons. Here, polypropylene is adequate, as is its tensile modulus, yield stress, and yield strain.

Fig. 4 Flexural strength and modulus comparisons. The strength is high, but stiffness is lower than most of the other rigid thermoplastics.







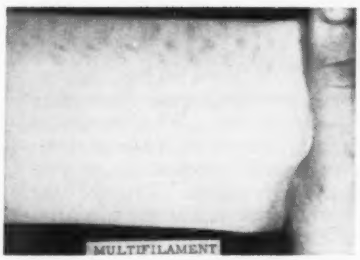


Fig. 1 Applications of polypropylene. Shown are extrusion, molding, film (for packaging), multifilament (woven into fabric). The new material has also been produced as sheet stock up to 0.125 in. for such applications as refrigerator liners and dishwasher covers. Automotive arm rests, electrical parts, hospital utensils, and hot-water valves have been made by injection and extrusion molding. Polypropylene may become the first practical plastic for home piping systems.

Fig. 5 Hardness is excellent. Hospital utensils made of Pro-fax have endured months of regular exposure to steam autoclaving.

Fig. 6 Heat distortion temperatures. Here is a plastic which can endure sterilizing temperatures—suitable for drug and food packaging.

Fig. 7 Volume change with temperature. For Pro-fax, the coefficient of linear expansion, from these curves, is 0.5×10^{-4} in. per in. per F.

Tensile modulus, yield stress, and yield strain are also adequate for most applications.

Will It Stand Impact?

The notched Izod impact strength (1.0 ft lb per in. of notch) is lower than that of amorphous polymers such as cellulose acetate butyrate. This is a characteristic difference between crystalline and amorphous plastics. In any case, actual field tests on items such as telephone handsets and automobile arm rests have indicated that the plastic has sufficient impact strength to meet most requirements. Oriented items such as film and filaments are high in impact resistance even at very low temperatures (−60 F).

Flexural strength and modulus comparisons are shown in Fig. 4. The flexural strength is excellent, being superior to that of most thermoplastics on the market. In stiffness, actual use tests have indicated that Pro-fax[2] is satisfactory for items such as pipe and vacuum-formed containers.

The hardness (Fig. 5) of 92 on the Rockwell R scale is excellent and is sufficient for all but the most severe requirements. Hospital utensils, in daily use for months, retain good color, gloss, and surface finish after regular exposure to steam autoclaving.

[2] Trademark of the Hercules Powder Company for their polypropylene.

Polypropylene has a crystalline melting point of approximately 165 to 170 C. This property is manifested in a high degree of heat resistance, and should permit movement of Pro-fax into applications where metals are directly replaced.

Use at Sterilizing Temperatures

The heat distortion value of Pro-fax, shown in comparison with some other plastics (Fig. 6), is one of its most significant properties, making it a low-cost plastic with heat resistance sufficient to allow its use at sterilizing autoclave temperatures.

Like all polyolefins, polypropylene has substantially zero water absorption. In addition, it represents the first hydrocarbon polymer that is completely resistant to stress-cracking. Both of these properties are of importance in the pipe, bottle, wire, and cable fields.

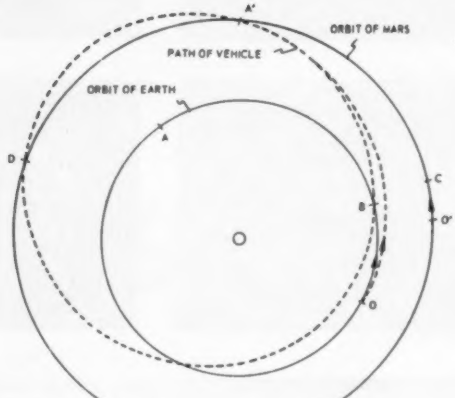
Also, as is true of other polyolefins, Pro-fax is suitable for high-frequency electrical use. The power factor and dielectric constant offer a somewhat better combination with Pro-fax, as compared to polyethylene. This is especially true under adverse conditions of temperature and humidity.

In Fig. 7, a comparison is made between Pro-fax and several other materials in the matter of volume change with temperature.

Abstracts and Comments Based on Current Periodicals and Events

D. FREIDAY
Assistant Editor

BRIEFING THE RECORD



Instrumentation for Flight to Mars

Looking to the next step beyond exploration of the Moon, a report has been prepared under Air Force sponsorship by J. H. Laning, Jr., E. J. Frey, and M. B. Trageser at the Instrumentation Laboratory of Massachusetts Institute of Technology on "Preliminary Considerations on the Instrumentation of a Photographic Reconnaissance of Mars." The paper was presented at the 2nd Annual Air Force Office of Scientific Research Astronautics Symposium sponsored jointly with the Institute of the Aeronautical Sciences, Denver, Colo., April 28–30, 1958.

"It is the considered opinion of the authors," the report states, "that a research and development program" on the technical feasibility of an unmanned photographic-reconnaissance flight to the planet Mars, "initiated today, could reasonably be expected to lead to the launching of such a vehicle within the next five to seven years." The report has been published for the exchange and stimulation of ideas.

Orbit

A nonstop round-trip—(Earth-Mars-Earth) space flight is proposed. The particular orbit considered for illustration departs from the earth on August 25, 1958, and passes within 5000 miles of Mars surface on January 25, 1959. After leaving Mars, it makes approximately one and three quarter circuits about the sun before returning to earth on October 6, 1961. Shorter trips appear to be possible.

The choice of such an orbit is desirable from the standpoint of propulsion. To orbit Mars as a satellite would require considerable extra fuel. To return to earth without waiting at Mars requires approximately two circuits about the sun.

Undeveloped Equipment

Although the propulsive power for the 300-lb 32-in-diam spherical vehicle envisioned is not discussed in detail, it is worth noting that the system used for Sputnik II would be capable of placing a 150-lb vehicle into an orbit to Mars, and "a figure of twice this amount would seem within our grasp in the period 1963 to 1965 without any strain on credulity."

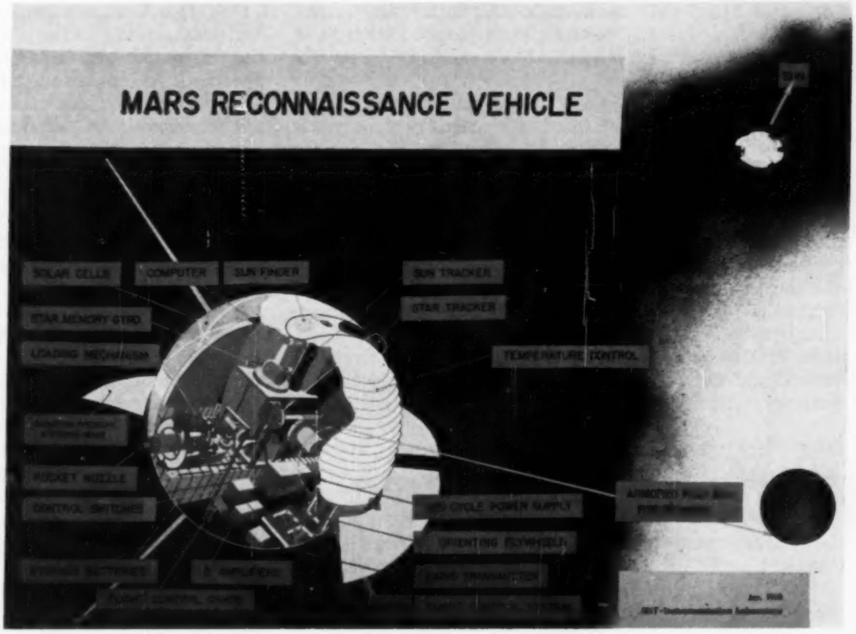
The authors also rely on the continuation of present trends in computer development to provide the general-purpose central computer that would be used in place of a variety of servo-control systems. The computer would have to combine a high degree of versatility and decision-making capacity with very low average power consumption, high reliability, and small size. What is not required is a high average rate of operation, or a large erasable storage. The computer would possess a large program of individual elementary orders. Through the flexibility of this sort of arrangement, a single computer could be made to control each of the many modes of operation of the vehicle, check that they were indeed being executed correctly, and direct alternate operations if a failure should be indicated. However, the program, once formulated, need never be changed; and in this sense the computer would be quite distinctly special-purpose in nature.

In the event of a total shutdown of the system, the computer could be arranged to restart automatically at a designated point, and generate from the beginning enough information to permit it to complete the voyage. It could even reset its own clock accurately to within 15 minutes by observation of the location of various planets.

In general, magnetic-core storage and logic seem to offer the most promise for this computer. A parallel type of computer operation is planned rather than serial operation, with an order code consisting solely of a rather small collection of logical operations, together with orders for moving information from one point to another. An arithmetic operation such as the addition of two numbers would thus appear as a subroutine. The reason behind this type of computer is that, at the expense of slowing down computation and increasing the size of program storage, the computer logic would be greatly simplified. This simplification, in fact, might be enough to permit a fair degree of redundancy of information so that the machine might detect and diagnose its own errors.

Continuous Adjustment to Environment

The concept of the vehicle—once launched—as gently floating through space in a completely undisturbed man-



Research initiated today could reasonably be expected to lead to the launching of a photographic-reconnaissance flight to Mars within the next 5 to 7 years. A proposed nonstop round-trip space flight would return to earth on October 6, 1961, if it had left August 25, 1958. In the trajectory diagram: *O* indicates the position of the earth, *O′* the position of Mars, at the time of launching; *A′* indicates the close pass of Mars, *B* the position of the earth at the time of input.

ner, the authors state, is unquestionably naive. A large part of the report deals with the problem of calculating a trajectory and scheduling travel so that the vehicle will reach the vicinity of Mars, orbit about the planet while mapping it from a distance of roughly 5000 miles, and then linger just long enough to return when the earth will be in the proper position for re-entry. The re-entry is expected to be determinable as at least over the North American continent and perhaps even a particular state may be selected.

While in flight, however, the vehicle must be continually contending with its environment in one way or another. In addition to inertial and celestial-navigation systems with vernier rockets for the correction of the course, variously oriented flywheels can be operated to control the orientation.

Solar radiation will power the electrical system, capable of delivering a peak of 25 watts of a-c power (a-c is used because of the greater reliability when brushes and commutators are eliminated). Solar radiation will also maintain a controlled internal environment with a narrow temperature range for the better functioning of the enclosed instruments. Half of the area of the ship toward the sun—approximately 2 sq ft—is occupied by solar batteries. These should have an output of approximately 4 watts when in the vicinity of the earth and will drop off to approximately 2 watts when near Mars. They will charge 30 lb of Edison cells which will store about 500 watthours. A transistor oscillator and amplifier capable of delivering 25 watts of 2-phase power and weighing about 2 lb would operate four or five accessories simultaneously, the maximum number required under any condition.

The other half of the sunlit area of the space ship would be occupied by the heat collectors of the thermal-control system for narrowing the 100 C temperature spread that would be otherwise encountered.

Even the sun's radiation pressure must be taken into account. The total of 1 dyne is sufficient that, if the center of pressure of the radiation is as much as 1 centimeter away from the center of gravity of the vehicle, the effect can turn the vehicle around completely within a few hours time.

Celestial-Navigation Equipment

The celestial-navigation equipment includes a star-tracking telescope, a sun-tracking telescope, and a sun finder. Control is achieved by developing co-ordinates from the angles indicated by these instruments and calculating the number of turns required of each of the orienting flywheels to correct the course.

The sun finder is a hemispherical dome, and either of the two flywheels normal to the sun-tracker line is directed to slew if this hemisphere is in total darkness. Soon the sun will illuminate half of this hemisphere and the shuttering device will give the computer information on its direction. Operation switches from the sun finder to the sun tracker and the flywheels bring the vehicle into precise alignment with the sun.

Even the failure of such a major piece of equipment as the sun-tracking telescope could perhaps be circumvented by the computer by the use of the one remaining telescope and a deliberately induced uniform angular rate of rotation of the vehicle.

Photographic Reconnaissance

The main telescope is of 3-in. aperture and 20-in. focal length. There are two field stops located in the principal focus for use in navigation. When the telescope is put to photographic use, an optically flat mirror is moved into the telescope tube to make the film in the re-entry package its focus. Contained in that package is a film-transport mechanism and focal-plane shutter for exposing several dozen frames of 70-mm film.

Since the camera's field of view at 5000 miles from the

surface of Mars will be an area 1000 miles across, the visible half of Mars can be completely mapped with 14 or 16 exposures. An f:6 lens would be used at $^1/_{25}$ or $^1/_{50}$ of a second.

Five space ships of similar design would probably be constructed—two to be used for earth-orbiting test flights, the remaining three launched for the trip to Mars and back.

A slightly more advanced design would permit release of a relatively small atmospheric probe at some distance short of Mars. The record of the acceleration of the probe as it entered the atmosphere of Mars would give the data required for a quite accurate speculation on atmospheric density and pressure, and temperature measurements and chemical tests could probably be made. Data would be telemetered to the space ship from the probe, and then carried back to Earth along with the photographic film.

Aluminum Bridge of Aircraft Design

Proved aircraft-design principles have been applied to an aluminum highway bridge that is sectionally fabricated, lighter in weight, and serves as its own form for the pouring of the concrete deck. Sections can be delivered by truck and quickly fastened together with a pneumatic device. "Packaged" small bridges are envisioned so that an engineer would need only to specify the type of crossing; whether straight, skewed, or curved, and to what degree; and the dimensions required.

Since 30 per cent of the highway dollar now goes into structures, the conservation of engineering skills and reduction of costs are apparent.

Demonstration of the test bridge, designed and built by Fairchild Engine and Airplane Corporation, was recently held on the Lehigh University campus at Bethlehem, Pa. Cosponsors of the test project are: Fairchild; the Bureau of Public Roads (U. S. Department of Commerce); Aluminum Company of America; Kaiser Aluminum and Chemical Sales, Inc.; Metals Division, Olin Mathieson Chemical Corporation; and Reynolds Metals Company.

Lehigh's Department of Civil Engineering was chosen as an independent agency to conduct the tests. William J. Eney, director of the Fritz Engineering Laboratory at Lehigh, who conducted the test sequence, stated: "This test is significant in that it is the first time a highway bridge of any type has ever been tested in the United States in a simulated-service condition to prove its structural adequacy and to insure fully satisfactory use during a lifetime of service.

"We installed 130 different instruments to record behavior of the prototype bridge under both static and dynamic-load conditions. Special Swiss-built pulsating jacks are being used to 'shake' the structure for more than one million cycles. This is equal to more than 100 years of normal use," Professor Eney said.

When the tests are completed, they will have included (*a*) 250,000 cycles of loads producing maximum design moment, (*b*) 250,000 cycles with load at 125 per cent of maximum design moment, (*c*) 1,000,000 cycles at loads producing 150 per cent of maximum design moment. Of this moment, all tests except half of those in group (*c*) have been completed. Loads are applied at midspan and with one exception simulate one truck in each of the two lanes. The one exception is an eccentric static test in which only one lane was loaded. A load of 125 per cent of design moment applied 6 ft from the center of the roadway twisted the bridge and very well demonstrated the inherent torsional rigidity.

Other advantages of the use of aluminum alloys in this design are its availability in odd shapes that may be economically extruded. The upper extrusions are mating members, designed to produce an interlock due to an interference fit and also to provide self alignment during field erection. The field assembly of this test bridge comprised placing the bearing plates on the abutments and bolting the three beams and two bottom plates with approximately 200 Townsend Lockbolts.

Aluminum alloy 6061-T6, which possesses about the best corrosion-resistant properties of the various alloys, was used. The bridge is of semimonocoque construction consisting primarily of a thin shell which is reinforced by a network of stiffening members. This is also referred to as stress-sheet design and is capable of reacting various types of loads in the plane of the sheet. Looking at the end of the bridge, one can draw a parallel between this structure and that found in most aircraft wings. All plating is reinforced with stiffeners to insure that they remain stable and do not buckle even with vehicular load 400 per cent above the load design.

A semimonocoque cellular structure of this type has excellent torsional rigidity to the extent that a load

Assembly of the prefabricated sections of the aluminum bridge structure—less concrete deck and preparation of site—took less than 2 days

Townsend lock bolts are used to join sections of the bridge in the field. The individual units are triangular in cross section.

placed eccentrically on one side of the structure activates all the material of all the beams, requiring the entire structure to contribute resistance to the load and not solely the local beams adjacent to the point of load application. This alleviates the requirement for the concrete roadway slab to act as the primary load-transferring member.

The bridge is of composite design, the concrete roadway serving as compression material for live and impact loads. This concept requires treating the bridge as two separate structures; first, with the roadway slab inactive when it must support the structural dead weight of the bridge along with the loads imposed by the wet concrete; and second, the composite structure of aluminum and concrete which reacts to live and impact loads.

The ends of the bridge are reinforced with additional plates and channel frames to redistribute the various loads into conventional bridge bearings. These bearings are of bronze and impregnated with oil so that they too require no maintenance whatsoever. Due to the difference in the coefficient of expansion between aluminum and concrete, two thermal beams have been designed at each end of the bridge to completely react all thermal variations.

Actual design of the bridge was accomplished at the Fairchild Kinetics Division in New York under the direct supervision of A. A. Gassner, division general manager. The bridge was fabricated at Fairchild's Aircraft Division in Hagerstown, Md.

Human Recognition Processes Simulated

The first nonbiological system capable of perceiving, recognizing, and identifying its surroundings without any human training or control has been successfully demonstrated and proved in concept by Frank Rosenblatt, research psychologist at the Cornell Aeronautical Laboratory, Inc., of Buffalo, N. Y., under contract for the Office of Naval Research at Washington, D. C.

Called "Perceptron" and closely paralleling the selective recognition or "similarity" functions of man's mind, the new concept opens up possible future applications which heretofore have appeared only in the realm of science fiction.

Although the pilot model of a machine designed specifically for these functions is about one year from completion, the Perceptron system has been effectively simulated on a conventional IBM 70 computer many times in proving its concept and practicability. It has in each case demonstrated the ability not only to "learn" what it is "shown" but also a capability of spontaneously "teaching itself" to recognize something, and then indicate what that particular something is, even though it has never "seen" it before.

The aluminum bridge serves as its own form for the concrete roadway which is poured directly on the top plate

In previous experiments, after being shown, or stimulated with 100 squares located at random on either the left or right sides of a rectangular visual field, the simulated Perceptron firmly associated one group of stimuli with "left" and the other group of stimuli with "right." This result was achieved with 97 per cent consistency at the end of 100 trials, and it was evident that the Perceptron system had "learned" to recognize the difference between left and right after it had "seen" only 30 to 40 stimuli.

Reading print and script, as well as responding to verbal commands, are within reach of the Perceptron. Only one step beyond the level which now appears attainable by the Perceptron lies the possibility of an automatic translator which can receive spoken inputs in one language and produce written or verbal outputs in another language.

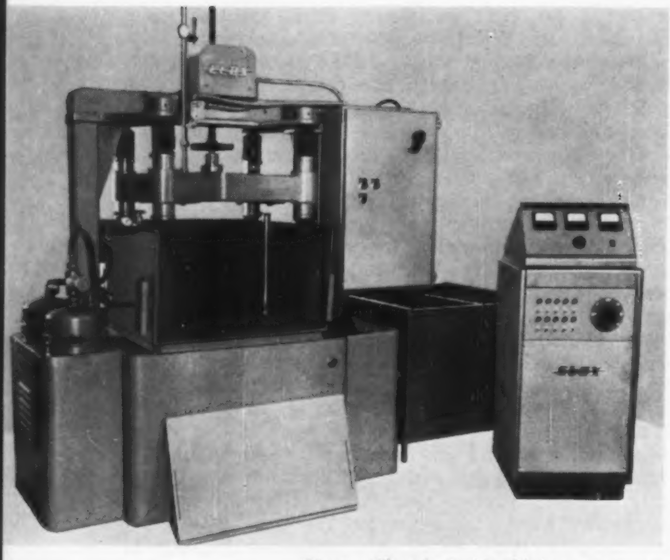
Perceptron does not recognize forms, shapes, or other items by matching them against a stored inventory of similar images previously fed into it by an operator, nor by performing a mathematical analysis of characteristics. Instead, the recognition is direct and essentially instantaneous, since the association by which a perceived stimulus is identified is derived in the form of new pathways through the system, rather than from a coded representation of the original stimulus. This is much like a man who gets a direct view of an object through his eyes, from which impulses flow through his nervous system to the brain, in turn enabling him to instantly recognize and identify that object for someone else.

As a model for the biological brain, the Perceptron does not violate any known information about man's central nervous system. Its size, the logic of its connections, the degree of reliability required of individual units, the permissible random variation in its "wiring diagram," and the kinds of signals employed, are all consistent with known anatomical and physiological data relating to the processes of the human mind.

Automatic-landing systems, automatic pilots, and recognition systems of almost every variety could conceivably make use of the Perceptron, and its application to research and data gathering from scientific purposes already seems clearly indicated.

Such applications, however, while actually within the realm of achievement, are still a part of the future, and really cannot be fully or properly evaluated at this stage of Perceptron's development.

Additional steps required for application will involve: Lowering the cost and size of its construction well below that of units which can now be built with conventional components presently available; studying the behavior of laboratory models in response to environments ranging from the mixture of simple geometrical forms, now being simulated by current programs, to such complex problems as the discrimination of speech and human faces; and development of sensing devices suitable for providing visual and auditory inputs to the system.



Electro-Chemical Machining uses an electrode submerged together with the workpiece in a saline solution to remove metal. A highly sensitive servofeed system automatically advances the electrode into the workpiece as the machining progresses.

Electro-Chemical Machining

The Research Division of Elox Corporation, Royal Oak, Mich., announces the development of an entirely new machining process—Electro-Chemical Machining, ECM—which permits completely electronic machining from start to finish with unprecedented metal-removal rates.

Using an electrode similar to that used in Electrical Discharge Machining, with both electrode and workpiece submerged in a saline solution, metal is removed by electrochemical action controlled by a highly sensitive servofeed system that automatically advances the electrode into the workpiece as the machining progresses. The currents that can be used by Electro-Chemical Machining are unlimited, and the gap between the electrode and workpiece that controls the accuracy of the finished product has a present low limit of 0.015 in.

Metal-removal rates are listed by Elox in ranges of 500 to 50,000 amp. Typical metal-removal rates using a 5000-amp power-supply rating would be 30 cu in. per hr with a minimum electrode area of 100 sq in. Using a 50,000-amp power-supply rating, metal-removal rates are 300 cu in. per hr with a minimum electrode area of 1000 sq in.

In addition to the extremely high metal-removal rates, Elox Electro-Chemical Machining offers many other unique advantages. Cost per cu in. of metal is low since the electrode can be reused many times without appreciable wear.

The electrode can be made of any conductive material such as lead, tin, zinc, or solder so that electrode preparation is minimal. The machines are safe and simple to operate and require little operation training. Compared to mechanical equipment, capital investment is low.

Both Houses Approve Euratom

Both the House and the Senate have given general approval to a joint U. S.-Euratom research and power-reactor program that the Administration proposed last June.

The two measures passed by the Senate and House last month were:

First, a concurrent resolution approving the broad International Agreement between the U. S. and Euratom signed at Brussels on May 29, 1958, and at Washington on June 19, 1958.

And second, an implementation law containing some but not all of the authority the Administration has hoped to receive from Congress this year to get the Euratom program under way by the AEC and the State Department.

According to the report published in the *Forum Memo* of the Atomic Industrial Forum, Inc., the approach of Congress in both of these measures was to extend only as much approval as was considered to be necessary for the program to be launched and to proceed until the next session of Congress.

The implementation law provided for the following:

1 Authority for the AEC to spend $3 million "as an initial authorization for fiscal year 1959" for the joint U. S.-Euratom research and development program. The Administration had asked for a $50 million authorization for five years and an appropriation of $10 million this year to get the program started.

2 Authority in principle, but no specific authorization of funds for the AEC to embark on a Euratom fuel-guarantee program not to exceed expenditures of $90 million. The Administration had requested an authorization for the full $90 million and an appropriation of $15 million this year to get the program started.

3 Authority in principle for the AEC to sell or lease 30,000 kilograms of U-235 and one kilogram of plutonium to Euratom subject to the terms of an Agreement for Co-operation yet to be submitted formally to the Joint Committee for review.

4 Authority in principle for the AEC to purchase special nuclear material, including up to 4100 kg of plutonium for peaceful use, from reactors in the joint U.S.-Euratom program, subject to the terms of an Agreement for Co-operation yet to be submitted formally to the Joint Committee for review.

Nuclear-Explosion Power

The Atomic Energy Commission is undertaking studies to determine the practicability of producing both power and radioisotopes from nuclear explosions. As a first step in the studies, consideration is being given to the detonation of a small device underground in the salt-bed area known as the Solado formation in the Delaware Basin, Eddy County, N. Mex., about 25 miles southeast of Carlsbad.

The project, if carried out, would be conducted in the summer of 1959 in a 1200-ft shaft drilled into the salt beds so that heat developed by the nuclear explosion would be confined to a relatively small area. Neutrons created in the nuclear reaction would be used to produce radioisotopes. The experiment would be of interest to scientists and industry. General scientific information on scaling laws, seismic effects, and geological data also

would be obtained from the detonation of such a device. As now planned, the yield of the explosion would be about 10 kilotons, the equivalent of 10,000 tons of high explosive.

Results of the September 19, 1957, Rainier test, fired at 800 ft underground at the Nevada Test Site, indicate that there will be no seismic or shock effects which would interfere with mining operations or other activities in the area selected for the experiment. Further studies are continuing to insure that the project may be carried out with complete confinement of radiation as accomplished in the Rainier test, without contamination of ground water tables, and without other effects on the area. Underground detonations of conventional explosions will be used as part of the preliminary studies.

An advisory panel of seismologists and geophysicists will review studies conducted by the Commission, University of California Radiation Laboratory, U. S. Geological Survey, and others to insure that the project is safe prior to a decision on conducting the experiment.

The New Mexico experiment is the second initiated under the Commission's Plowshare program to investigate important peacetime applications of nuclear explosives. As previously announced, studies are being conducted on the Alaska Coast between Cape Seppings and Point Hope to determine the practicability of excavating a harbor.

Portable Jet-Engine Silencers

The Metal Products Division of Koppers Company, Inc., Baltimore, Md., has disclosed the development of a unique silencer which can be adapted for use with any type of jet aircraft, commercial or military. The Navy has contracted for 30 portable jet-engine silencers for use at various Naval airfields throughout the country. There is no attachment to the aircraft itself. The silencer is simply rolled into position behind the engine. According to Koppers acoustical engineers, it is the first completely portable silencer to be successfully tested behind a jet aircraft.

Tests have shown that the Koppers air-cooled silencer reduces jet noise by as much as 30 decibels, equivalent to a 90 per cent reduction of the impact on the eardrum. This is enough to prevent hearing damage to operating personnel and to effectively protect close neighbors from jet noise. The silencer employs certain design features developed by The Martin Company which Koppers is authorized to use under a license agreement recently concluded between the two companies.

The Navy silencers will be used with the most powerful jet engines in production including the J-57, J-65, J-71, J-75, and J-79.

Heat Transfer and Mixing

A continuous-processing machine capable of transferring heat to or away from materials as it mixes is announced by the Chemical Machinery Division of Baker Perkins, Inc., Saginaw, Mich. The unit is essentially a continuous reactor combining continuous mixing with accurate process-temperature control.

Because of the multiple action of the machine it can be used for emulsifying, cooling, and heating in the manufacture of lubricating greases and wax. In applications requiring reaction temperature control, the unit can be used for paint, plastic, general polymerization, sulphonation processes, and modifying drying oils. It also can be used for synthetic-fiber manufacture, specifically in dope heating and cooling, gel removal, and viscose heating and cooling.

Called the Flowmaster reactor, the machine consists of a series of fixed heat-transfer plates through which a heat-transfer fluid may be circulated or, alternatively, the plates may be direct electrically heated.

Spaced between each heat-transfer plate are beaters mounted on a common shaft. The beaters intensively mix, in a relatively small volume, the material flowing through channels of each transfer plate. Besides mixing the incoming material, the greater degree of turbulence creates a thin film giving higher heat-transfer coefficients than obtainable on conventional equipment.

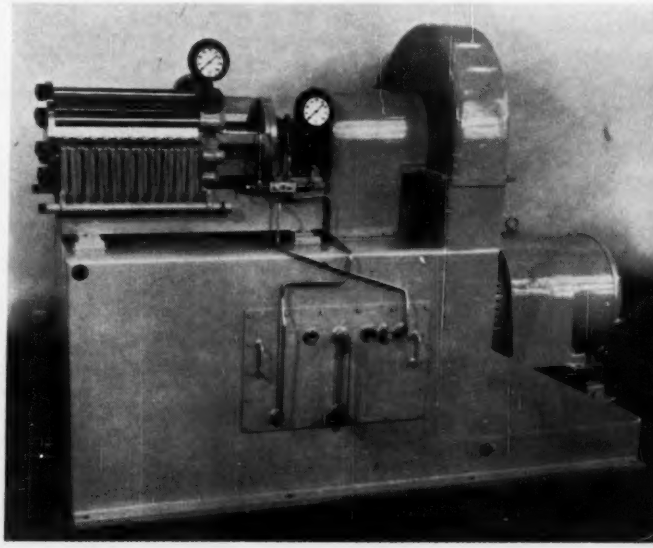
The machine is built with maximum working pressures up to 350 psig and operating temperatures from 32 to 400 F. Special machines may be manufactured with working pressures up to 1000 psig and temperature range to 750 F.

Although the reactor can be built to meet individual requirements, the company basically manufactures the reactor with two standard-size heat-transfer plates—11 and 18 in. in diameter.

The complete reactor can be stripped to the bare beater shaft and reassembled quickly with the use of special handling equipment. In addition, the heat-transfer plates, beaters, and so forth, are interchangeable with other machines of the same size.

Normal construction of the machine is of stainless steel, but it can be constructed of alternate materials such as nickel.

Heat is continuously transferred to or away from materials as they are mixed in the Flowmaster reactor. As built, the machine has maximum working pressures up to 350 psig and operating temperatures from 32 to 400 F. These can be extended to 1000 psig and 750 F in specially made machines.



Brookhaven National Laboratory

THE substantial contribution which engineers are making to fundamental research through the development of new research tools and techniques was pointed out by Gaylord P. Harnwell, president of the University of Pennsylvania, at the 1957 ASME Fall Meeting in Hartford, Conn. Brookhaven National Laboratory at Upton, N. Y., offers a good demonstration.

Engineering is not only a major area of research at BNL but plays a major part in the technical services of the Laboratory. Nuclear engineering accounted for $2^1/_2$ million or 17.8 per cent of the total operating expenditures in fiscal 1957. This was exceeded only by the combined physics and chemistry category of research.

The Mechanical Engineering Division

The design of equipment for the research staff is a major function of the 20 engineers in the Mechanical Engineering Division. This has ranged from a "mouse hotel" for the Biology and Medical Departments to the machine components for the 30-Bev proton accelerator now being built. Eleven engineers and 13 designers and draftsmen are assigned to the complex problems of developing that machine. The principle of the Alternating Gradient Synchrotron, AGS, as the machine is called, was developed at BNL. An 842-ft-diam circle of alternately facing magnets creates strongly converging and diverging magnetic fields which confine the proton beam in a vacuum chamber of relatively small cross section. This focusing effect allows the production of high-energy beams with smaller electromagnets and related equipment than would otherwise be possible. The steel for the magnets which are currently being delivered was manufactured by Allegheny-Ludlum, and the stamping, laminating, and assembly of the individual sections were done by Baldwin-Lima-Hamilton. Particles are tangentially injected into the field of the AGS from a 50-Mev linear accelerator when their speed is synchronous with that of the AGS. With each rotation on the AGS they are given 12 8000-ev boosts as they continue on their merry-go-roundlike circular path at 3×10^5 circuits per second and pass each of the 12-radiofrequency acceleration stations. When fully accelerated they may be deflected in a target area to bombard samples for experimental purposes.

The machine will have three times as much power as the present world's largest—the 10-Bev Russian accelerator which has been undergoing modifications for the past year in an effort to bring it up to rated power.

The 3-Bev Cosmotron, the largest accelerator in operation at BNL, requires four engineers and a like number of designers and draftsmen.

A large hydrogen bubble chamber for the Physics Department is another major project of the engineering division. A high-pressure liquid-hydrogen-generating facility will be an important auxiliary.

All these facilities, the AGS, the Cosmotron, and the Bubble Chamber are key research instruments for what might be called BNL's central function—fundamental research in nuclear physics. Greater emphasis is being placed on fundamental research in all BNL activities, and in the applied areas the current philosophy is to go back and take another look. Practical application has proceeded at such a pace that the processes, their limitations, and the basic mechanisms involved are little understood. The theoretical structure is being filled in, in order to be able to proceed from generalizations.

Engineering Research

The primary research function of the Nuclear Engineering Department is the development of the Liquid

BROOKHAVEN NATIONAL LABORATORY

A weld is examined in the out-pile section of the Liquid Metal Fuel Reactor processing loop. The fuel is removed from the pile at various points for processing to eliminate fission products by degassing and salt-processing methods.

The 842-ft-diam 30-Bev Alternating Gradient Synchrotron which gives protons 12 8000-ev boosts on each rotation at 3×10^5 circuits per sec

The radiation source for the 10-acre gamma-radiation field is safely underground but moves up the 7-ft pipe by remote control, when the field is unoccupied, to furnish radiation for experiments

Metal Fuel Reactor. Uranium fuel dissolved in molten bismuth fissions when a sufficiently large or critical mass is accumulated. In essence, the reactor is simply a 5-ft-diam perforated graphite cylinder with an inlet and outlet pipe. The same liquid-metal-with-fuel combination serves as primary coolant carrying the heat of the reactor to an exchanger where secondary coolant can carry it to a steam generator.

An alternate arrangement, in which the liquid metal fuel is used to heat a gas in the reactor core, after which the hot gas passes to a closed-cycle gas turbogenerator set, was described by L. D. Stoughton, Assoc. Mem. ASME, and T. V. Sheehan, Mem. ASME, of the BNL staff, in the August, 1956, issue of MECHANICAL ENGINEERING, pp. 699–702.

The concept, which is one of the reactor types listed by the AEC for development, introduces difficult metallurgical and chemical-processing requirements. Low-chrome steels have been explored extensively with thermoconvective and pumped loops, some of which have operated 30,000 or 40,000 hr. There is a mass-transfer problem since slightly soluble constituents of the steel are redeposited at the cold end of the loop. A 4-in. loop with components equal in size to those of a projected reactor experiment is now being installed at BNL.

Babcock & Wilcox, who have been contractual partners in the development work, are beginning final design for a 5-mw reactor experiment whose heat will be dissipated to atmosphere. This will require 3 years for building and is expected to give about 2 years of test operation.

Continuous fuel processing, which is complicated—about one third of the fission products are gaseous and a number of auxiliary systems are required—is being critically examined. For a 2-yr experiment, excess reactivity can easily be provided by simply adding new fuel to override the fission-product poisons as they build up.

Research Program

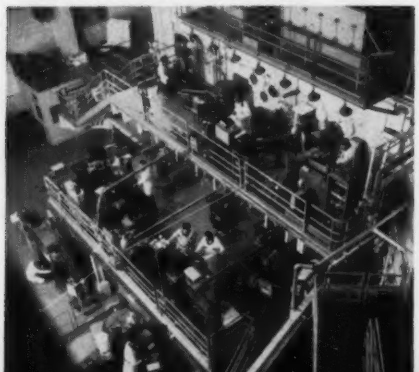
Nearly all of BNL's research is now unclassified and dedicated to the peaceful uses of atomic energy. A 10-acre gamma-radiation field has a 2000-Curie cobalt-60 radiation source for plants, which are arranged in circular rows. Radiation-induced genetic mutations have already yielded new varieties of peaches which will extend the crop an entire month, and rust-resistant varieties of oats and wheat.

Medical research is another major radiation application. Iodine-131 tagging is used to study protein metabolism, carbon-14 for carbohydrate metabolism, and other isotopes for study of such fundamental body processes as mineral and vitamin utilization. Localization of radiation effects by using boron-10 to seek out tumor tissue in treatment of certain types of cancer is promising and has been successfully used with terminal cases on a highly malignant form of brain tumor for which there was no satisfactory treatment. Treatment with the regular BNL research reactor required shutdown of other activities, and a special Medical Research Reactor and hospital facilities are under construction.

Even a brief synopsis of the research activities in biology, chemistry, medicine, engineering, and physics requires a 130-page annual report. These activities are guided by Visiting Committees composed of university, industrial, and governmental research personnel. BNL is operated by Associated Universities, Inc. (Columbia, Cornell, Harvard, Johns Hopkins, M. I. T., Princeton, Pennsylvania, Rochester, and Yale) under contract with the AEC. The nearly 300 members of the research staff are augmented by salaried visitors and by guests whose number in summer almost equals the staff. A thoroughly modern research center has emerged as the remaining temporary buildings from wartime Camp Upton are replaced with permanent structures.

A 1/2-mile-circumference tunnel will house the Alternating Gradient Synchrotron, the most powerful in the world, and three times as powerful as Russia's accelerator. Alternately facing magnets create strongly converging and diverging magnetic fields which confine the proton beam in a vacuum chamber of relatively small cross section.

Experimental space is closely packed on the west face of the research reactor. Each company, government agency, or university designs its own experiments.



This loop, inserted into the research reactor, permits radiation of the 1000-F molten-bismuth and uranium-alloy fuel and coolant in the LMFR

Medical Research Center will have four circular 12-bed nursing units, laboratory, and reactor for medical treatment

EBWR Turbine-Blade Failure

Investigation of the failure of the turbine generator of the Experimental Boiling Water Reactor EBWR, at the AEC's Argonne National Laboratory, Lemont, Ill., has disclosed that the failure was caused by excessive stress resulting from a notch in a blade root.

The EBWR was shut down on May 1, because of the turbine failure. The turbine rotor was removed and examination by the manufacturer, Allis-Chalmers Manufacturing Company, disclosed that one of the turbine blades and its shroud became detached from the rotor. A row of new blades was installed and the turbine delivered full power again on June 4.

The manufacturer's report stated that an examination of its manufacturing procedures indicated that one of the clamps used to hold the blades during machining had been incorrectly adjusted, causing the notch. The report also stated that there was no evidence of stress corrosion or other forms of surface attack, and that the blades were not affected by steam from the reactor.

Maintenance operations were permissible inside the turbine on a routine basis almost immediately after the shutdown because the radioactivity level was only 2 milliroentgens per hr. Current radiation-protection standards limit exposures to 3000 milliroentgen per 3-month period and to an average of 5000 milliroentgens per yr.

Laminated Roof

A CONTRACT has been awarded to Summerbell Roof Structures Division of The Fluor Corporation, Ltd., to engineer, fabricate, assemble, and erect a glued-beam plywood-deck combination-roof system to cover the mammoth Oakland Distribution Center of Montgomery Ward and Company at San Leandro, Calif.

The contract, awarded by The Austin Company, engineers and builders, calls for the most extensive use of laminated construction since World War II.

The warehouse will be 960 × 600 ft or approximately $13^1/_2$ acres under one roof. More than 1000 glued-laminated beams, of various sizes, will be required to support the panelized roof structure.

Commercial Powder-Metal Strip

MAJOR problems of producing high-quality hot-rolled strip from metal powder have been solved, and commercial production of copper strip from metal powder will soon be a reality. While most development work has been in copper, the system has shown practical application to many other metal producers.

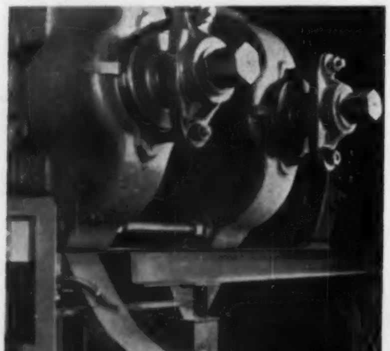
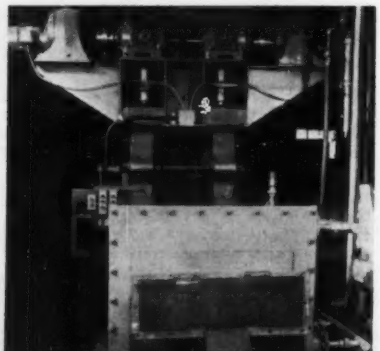
High-quality hot-rolled strip can be produced from powder at savings of about 80 per cent of conventional equipment and rolling costs.

The E. W. Bliss Company, developer of the process in conjunction with the Chemetals Corporation of New York, N. Y., and others, has announced that its own tests, those of a major producer of copper products, and the findings of independent testing laboratories, reveal that: (*a*) Copper strip produced from powder has higher mechanical properties than electrolytic-grade copper strip produced by conventional methods; (*b*) the oxygen content is substantially lower in strip produced from powder than in electrolytic-grade strip.

The powder is first fed through a hopper-and-guide arrangement through a mill for green compacting, and is passed continuously into a protective-atmosphere heating furnace for sintering. On delivery from the furnace it is immediately hot-rolled, with further reduction or reductions. Then, depending on the material, it may be sintered and hot rolled again to produce metal completely consolidated to 100 per cent density.

The powder-metal copper coils used in the tests to be described were 0.040 in. gage, 6 in. wide, and 100 to 200 lb in weight. After production by the powder-metal process, they were annealed and cold rolled to 0.010 in. on a conventional four-high rolling mill, and were cold-rolled without edge cracks or other difficulty. After cold rolling, they were again annealed.

Powder-metal strip: *Step 1,* copper powder is fed into a hopper-and-guide arrangement—in commercial operation mechanical feeding would be used; *step 2,* special rolls and feed devices were developed to produce green compact of uniform thickness with edges that are uniform, sound, and square; *step 3,* high-quality hot-rolled copper strip is the final product which comes out of the furnace, where it has been sintered in a protective atmosphere

New Thermoelectric Materials

Scientists at the Westinghouse Research Laboratories, Pittsburgh, Pa., have discovered a new, "essentially unexplored" class of materials which can convert the heat of a burning fuel, or other high-temperature source of heat, directly into electricity.

Such substances, called thermoelectric materials, produce electricity simply, silently, and without moving parts of any kind. Because of the potential importance of its practical applications, this method of electric-power generation is the object of intense scientific research throughout the world.

Discovery of the new thermoelectric materials was announced at a technical conference on thermoelectricity sponsored by the U. S. Naval Research Laboratory, on September 3, in Washington, D. C., by Clarence Zener, director of Westinghouse research.

To be useful for power generation, a thermoelectric material must operate at the elevated temperatures encountered in a burning fuel, nuclear reactor, or other primary source of heat, and at the same time, must make the heat-to-electricity conversion with reasonable efficiency.

For many years the thermoelectric effect has been observed in metals, most of which easily withstand the required temperatures. But because they are good conductors of heat and electricity their maximum thermoelectric efficiency is of the order of one per cent—far too low for power purposes.

More recently, the thermoelectric effect has been found in semiconductors—the class of materials so widely used in making transistors and other "solid-state" devices. Certain semiconductors exhibit quite reasonable thermoelectric efficiencies, but not at the elevated temperatures at which power is usually generated.

The new Westinghouse thermoelectric materials are believed to be the first to be discovered in the general category of substances that characteristically are insulators, or nonconductors of electricity. These thermoelectric materials are ceramics.

The ability of ceramics to withstand high temperatures is well known. As far as is known, the ceramic-type materials used in the experiments are the first solid-state thermoelectric substances to operate with what are considered promising efficiencies at temperatures in the range of 2000 to 3000 F.

The new Westinghouse thermoelectric materials are technically described as "mixed-valence compounds of the transition metals." In mixed-valence compounds, atoms of the same element have different amounts of charge within a single molecule.

Study of mixed-valence compounds began several years ago because of their interesting magnetic properties. The discovery of their thermoelectric possibility was one of the unexpected results which often come from basic scientific research.

The transition metals are a group lying near the center of the natural table of elements and include such common examples as iron, nickel, and manganese. In contrast to solid-state materials heretofore proposed for thermoelectric power generation, the new compounds were described as inexpensive, easily available, simple to prepare, and not composed of critical elements in short national supply.

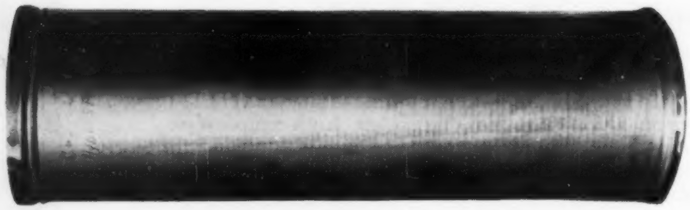
Being ceramics, they are inherently stable and chemically inactive, even at very high temperatures. They can be heated indefinitely in air with an open flame without deterioration; they do not require chemical preparation to an extreme degree of ultrapurity; their use raises no technological problem of high-vacuum operation, complex electric or electronic apparatus, or the like.

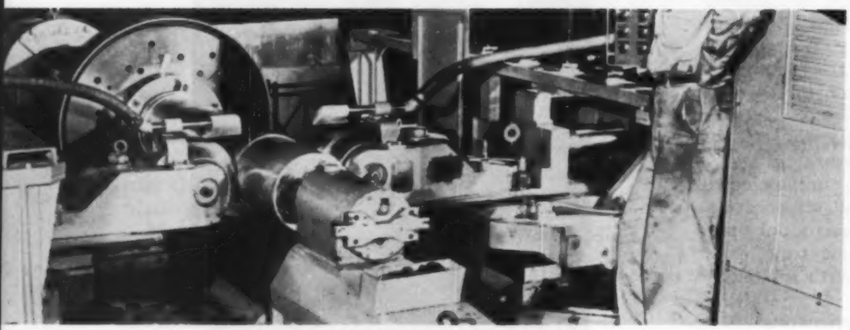
A special furnace prepares the thermoelectric materials. For experimental purposes the powdery materials are pressed into pellets. The new Westinghouse thermoelectric materials are believed to be the first in the general category of substances that are characteristically insulators, and are classed as ceramics.

The work with these new thermoelectric materials is still in its early stages, and they do not exhibit the efficiency demanded by conventional methods of power generation. However, for specialized applications, where compactness, light weight, and simplicity are more important considerations than efficiency, they offer promise for practical applications requiring small quantities of electric power.

To date, the work with these new compounds has been encouraging, and no theoretical roadblock to their expected usefulness has been discovered. Much basic work still remains to be done and a great deal of technology is still to be developed, but the day of useful, reasonably large-scale thermoelectric power through these and other thermoelectric materials almost certainly lies in the not-too-distant future.

Westinghouse scientists do not anticipate that thermoelectric power will make obsolete present methods of generating large-scale quantities of electricity. Rather, if large-scale thermoelectric power generation does prove feasible, its function will probably be to supplement conventional methods or provide power where conventional methods are undesirable or impractical.





Airsteel X-200 was shaped into the ¼-in-thick welded cylinder blank, *top left*, and hydrospun to produce the 0.080-in-thick cylinder, *top right*. After hydrospinning, *bottom*, simple heat treating developed the ultra-high-strength levels that would require oil quenching with other steels.

Hydrospun 280,000-Psi-Tensile Steel

Tested and evaluated under the laboratory designation of Airsteel X-200, a new ultra-high-strength alloy sheet steel for missiles and rockets has been developed by U. S. Steel Corporation's Research Center in Monroeville, Pa. Commercial heats have been produced or processed at several U. S. Steel mills across the nation.

Airsteel is an air-hardening missile material which, when cooled in air and tempered, develops tensile-strength levels in the 280,000-psi range. Most other alloy steels require an elaborate oil or salt quenching to develop equivalent mechanical properties.

The huge quenching tanks and uneven strength levels or distortion due to uneven quenching action are eliminated together with elaborate straightening methods.

U. S. Steel plate and sheet mills produce Airsteel in the annealed or "soft" condition. This allows easy forming, cutting, or shaping to desired missile configuration.

Fabricability tests with Airsteel included forming, fitting up for welding, welding, heat-treating, and hydrospinning. Various types of missile-motor cases were made with and without longitudinal welds.

The weldability study showed that the welded joint was equal to the ultra-high-strength level of Airsteel itself. Production methods of welding evaluation during the study included metallic-arc and inert-arc welding.

Results of the tests showed that the new steel is highly suitable for missile applications including large-diameter, thin-wall motor cases.

At Consolidated Western, a typical Airsteel missile component, after forming and welding the annealed condition, was heated to an established temperature and allowed to air cool to room temperature. This operation air hardened the steel. A tempering treatment at a lower temperature followed by air cooling, imparted ductility and toughness so that the metal was not brittle.

Although developed specifically for missile application, the new alloy steel is also available for other uses, and supplied in billets, blooms, bars, plates, and sheets.

Engineering Studies on Nuclear Seaplane

A contract for more than $385,000 has been awarded by the Navy to The Martin Company's Baltimore Division to extend engineering studies on a nuclear-powered seaplane. The Martin study is part of the Navy's program to develop a long-range, long-endurance turboprop seaplane for antisubmarine warfare, air early warning, and cargo transport.

In addition to studies of new airframe designs based on present engine developments, the Martin study will cover power-plant requirements involved in modification of existing airframes, and other areas in which nuclear propulsion could be applied to Navy weapons systems.

The Navy, which has had feasibility studies under way since 1946 in collaboration with the Air Force and the AEC, previously announced that existing airframes under consideration for the nuclear power plant include the British Princess seaplane, built by Saunders-Rowe Ltd.

The Martin study program will also include facilities and handling requirements, operation-analysis studies, and nuclear-reactor shielding techniques.

The studies will provide the basis for development of a fleet-operational nuclear-seaplane system in the 1964–1965 period.

In addition to providing an extremely-long-range aircraft useful for antisubmarine warfare and air-early-warning flights, this type aircraft has outstanding potential as a cargo carrier. It is estimated that a nuclear seaplane of 2,200,000-lb gross weight could carry a 770,000-lb pay load for virtually unlimited ranges—something impossible with gasoline or chemically fueled planes.

Plutonium-Fueled Power Reactor

An AEC reactor is operating for the first time at substantial power with plutonium-239 as the fuel. The Materials Testing Reactor, MTR, at the Commission's National Reactor Testing Station in Idaho, normally fueled with U-235, was brought to criticality with plutonium as its fuel in August, and is now operating at a power level of 5000 thermal kw. Following tests, operation is expected at the 30,000-kw design power level.

This experiment with a plutonium fuel loading is expected to advance the technology of plutonium fuel-element handling and fabrication, provide operational experience with a plutonium-fueled reactor, and provide reactor-physics data.

Only minor design changes were required for the use of Pu-239 rather than U-235 as the fuel. The amount of Pu-239 required for an MTR fuel loading is less than for U-235 because of differences in their nuclear properties. As an additional experiment with fuel loadings of different fissionable materials, the MTR, after a test period of power operation with the plutonium loading, will be loaded with fuel elements fabricated with U-233, the synthetic isotope of uranium derived from thorium. In a previous experiment, the MTR was operated successfully with a core loading of fuel elements containing uranium enriched to 20 per cent in U-235 rather than the usual high enrichment of 93 per cent.

The plutonium fuel elements were fabricated at the Hanford Works, operated for the Commission by the General Electric Company. The MTR is operated for the Atomic Energy Commission by the Phillips Petroleum Company.

Larger "Perfect" Crystals of Metal

Dislocations, the rows of out-of-line atoms that scientists now blame for making metals "much weaker than they ought to be," have been completely eliminated from crystals of silicone larger than a man's finger.

In making these "perfect" crystals in unprecedented size (previously reported perfect crystals have been whiskers thinner than a human hair), scientists at the General Electric Research Laboratory have: (*a*) Disproved a prevalent idea that dislocations "have to be there or crystals can't grow"; (*b*) found important new knowledge about the causes of dislocations and how to get rid of them; (*c*) opened a door that may lead to making dislocation-free, and perhaps super-strong, crystals of a variety of materials in large sizes; (*d*) determined that elaborate precautions will have to be taken to protect the surfaces before superstrong "perfect" crystals can be used for structural purposes. The dislocations which cause weakness apparently can be easily induced into crystals by minor surface damage.

A perfect rod of 1-in-diam iron, if it could be made, might be as strong as a huge I-beam. The catch is that even a small scratch made with a needle might induce dislocations that would propagate when stressed, making the rod a hundred times weaker.

Discoverer of the new crystal-growing technique is William C. Dash, General Electric physicist who described the work at an International Conference on Crystal Growth in Cooperstown, N. Y., sponsored jointly by the U. S. Air Force and the General Electric Research Laboratory.

The secrets of Dr. Dash's techniques involve the use of specially tapered "seeds" made of high-perfection material. In this way he reduces the thermal shock experienced by the seed when it first touches the hot molten silicon from which the crystal is grown. Equally important is pulling the crystal in the proper crystallographic direction, so that dislocations are literally "left behind" as the crystal grows.

Purity of the material is important but is not a critical problem. Dr. Dash's largest dislocation-free crystal, which weighs about 2 oz, is similar in purity to silicon used for manufacturing transistors and other semiconductor devices—a few impurity atoms per million silicon atoms.

The strength differences between pieces of silicon with and without dislocations can be observed in a meaningful way only at temperatures of about 900 C or greater. Strength-testing of the silicon crystal is difficult because of the high temperature required and the fact that anything used to grip the sample tends to induce the strength-dissipating dislocations. Nevertheless, it has been established that those without dislocations are definitely stronger at high temperatures.

Extremely strong, whisker-size crystals of iron, copper, and many other metals have been made at the General Electric Research Laboratory and at several other laboratories. In the case of iron, strengths up to nearly 2 million psi have been observed, five times the tensile strength of the strongest piano wire. As a result of Dr. Dash's studies, there is the prospect of making large-size perfect crystals of many substances with high strength—provided that the surfaces are protected.

The absence of dislocations in Dr. Dash's large silicon crystals has been ascertained: (*a*) By surface observations of a chemically etched surface; (*b*) by "decoration," a method in which copper is precipitated along the dislocations inside the silicon crystal; the dislocations, or lack of them, can then be observed by "looking through" the silicon, which is transparent to infrared light; (*c*) by x-ray inspection.

While work is being directed toward growing dislocation-free crystals of a variety of metals, the only other material in which results have been observed similar to those in silicon is germanium, also a semiconductor. Arthur G. Tweet, another Research Laboratory physicist, has used this same technique to grow dislocation-free crystals of germanium.

The role of dislocations in determining the strength of crystalline solids has been part of new theories evolving during recent decades. It has been shown that *plastic* deformation of metals is accomplished when dislocations permit planes of atoms to slide over each other. In the absence of dislocations, the theory suggests that metals can be bent further *elastically*.

Ford Computer Laboratory

Aeronutronic Systems, Inc., a subsidiary of Ford Motor Company, is constructing a 115,000-sq ft computer-development building at Newport Beach, Calif.

The complete building will be a fully equipped structure for research, development, and manufacture of special-purpose computers and electronic systems for military and commercial application.

PHOTO BRIEFS

1 **Semicontinuously Cast Copper Alloys.** Liquid metal from the Ajax electric induction furnace flows along a launder to a distributor which insures a smooth splash-free entry of metal into the molds. The metal cools rapidly in passing through water-jacketed "bottomless" molds and is solid by the time it leaves them. Molds are continuously filled with molten metal to match the withdrawal of the solidified castings. The machines made by Lobeck Casting Processes, Inc., of New York, N. Y., for The American Brass Company produce multiple-strand extrusion billets of various copper alloys up to 8 in. in diam and rolling-mill slabs up to 6 x 24½ in., in lengths up to 12 ft.

2 **Continuously Cast Aluminum Alloys.** Six direct-chill casting stations at the recently completely integrated smelter-rolling mill of Kaiser Aluminum at Ravenswood, W. Va., are capable of casting simultaneously as many as four of these 10,000-lb slabs. The continuous-casting equipment made by Loma Machine Manufacturing Company, Inc., of New York, N.Y., can produce even highly alloyed aluminum slabs up to 16 in. thick, 56 in. wide, and 180 in. long.

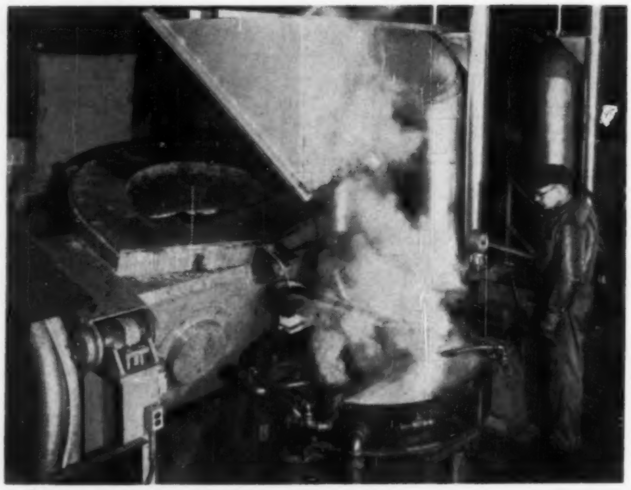
3 **Modular Enclosures.** Scale-model modular enclosures developed by Elgin Metalformers Corporation of Elgin, Ill., aid in the selection of mass-produced metal-cabinet enclosures for housing electronics, automation, and instrument equipment.

4 **Air-Conditioned Harvester-Thresher.** Heated air or fresh filtered air is circulated in the closed cab of International Harvester's new threshers. Completely air-conditioned units are optional.

5 **Shot Down.** Intercepted by Lockheed's electronic firing-error indicator, the 38-ft-long Kingfisher is a specially designed and instrumented supersonic target missile equipped with a radar antenna which enables it to simulate aircraft or missiles up to five times its size.

6 **Precision Honeycomb Core.** Six years of research and development are behind special machines developed by Solar Aircraft Company to form and weld a precision honeycomb core of extremely thin foil to any length and width. Forming rollers to the right of the machine corrugate the metal strips which are welded layer by layer onto the circling loop of completed core.

7 **Push-Button Dock.** Each of 25 boat-loading feeder belts can be controlled independently to load and trim preset quantities of pelletized taconite to each hatch at 750 or 1500 tons per hr. The 42-in-wide, 96-ft-center belt conveyers, part of the iron-ore handling-and-loading equipment made by Link Belt, are spaced to fill alternate hatches, and require only one shift of the ore boats. They can be extended 50 ft from the face of the dock. The functions of feeding, conveying, advancing, retreating, and weighing are controlled separately for conveyers from one of two control towers on top of the 120-ft-long dock capable of loading two vessels simultaneously.



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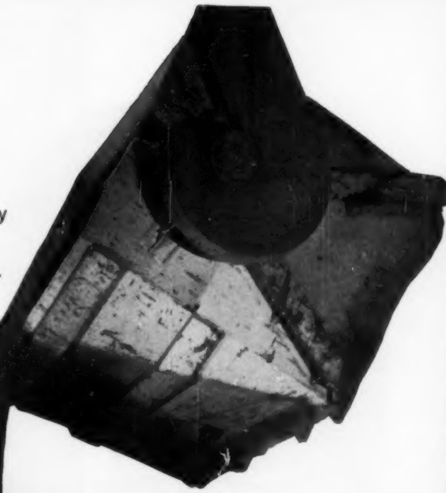
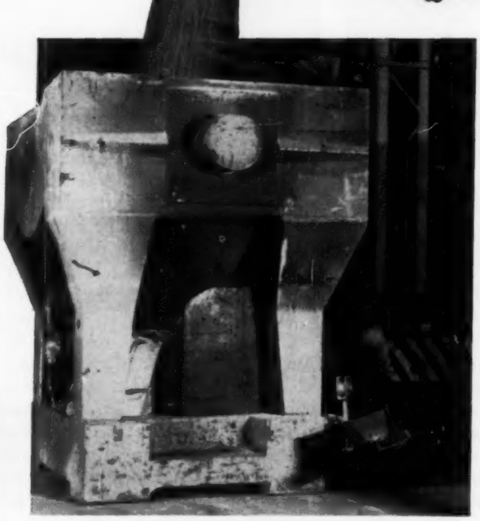
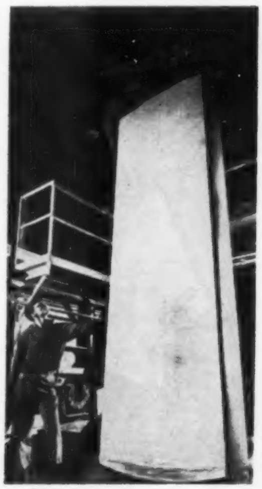
Transfer Bin.
Dolomite for open-hearth-furnace linings is poured from an 815-cu-ft capacity welded-steel transfer bin into a dolomite machine which will feed the stone into the furnace. Both bin and machine built by the Blaw-Knox Company of Pittsburgh, Pa., are crane-handled.







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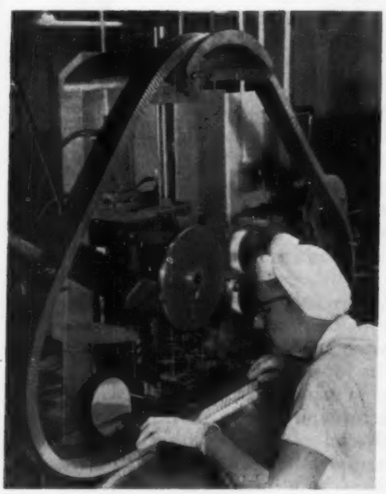

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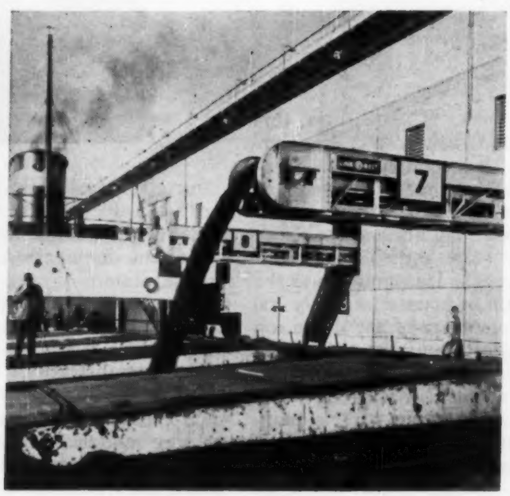


Engineering Progress in the British Isles and Western Europe

J. FOSTER PETREE
European Correspondent

EUROPEAN SURVEY

Power-Line River Crossing

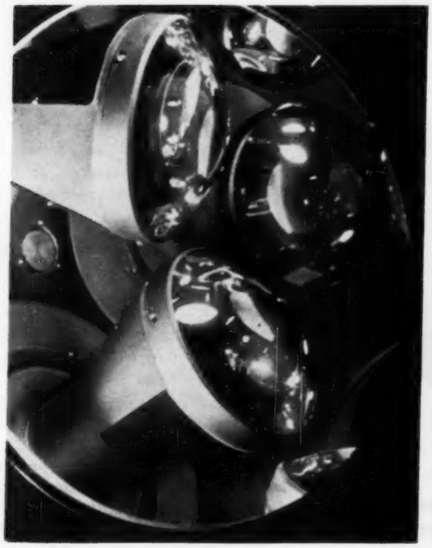
Work is now proceeding in the West of England on what will be the longest and highest electric-power-line river crossing in the country, to carry the 275,000-volt double-circuit "Supergrid" across the rivers Severn and Wye. The span over the Severn will be more than a mile long and that over the Wye about 1300 yd, the total length including anchor spans being nearly $2^1/_4$ miles. The tallest towers will be 488 ft high. The six current-carrying conductors and the earth wire will be slightly over $1^1/_2$ in. in diam and will consist of a core of 91 steel strands in a sheath of 78 aluminum strands. It is claimed by the Central Electricity Generating Board that they will have a higher ultimate strength than any conductors yet manufactured in the world. Each length of conductor will weigh 23 long tons. There is an existing grid which operates at 132 kv, but this is not so much a supply system as an insurance against local failures, enabling stations to feed current into other distribution areas in an emergency; it is not adequate to transmit the entire output of the large new stations, now under construction on the coal fields, to the areas where it will be needed. This will be the function of the Supergrid, of which 500 miles have been built and another 1000 miles are under construction. It will be carried on 9000 steel towers and by 1960 should be carrying annually the electrical equivalent of 8 million tons of coal. Part of it is designed for eventual operation at 380,000 volts.

Projector for the London Planetarium, the first to be erected in the British Commonwealth

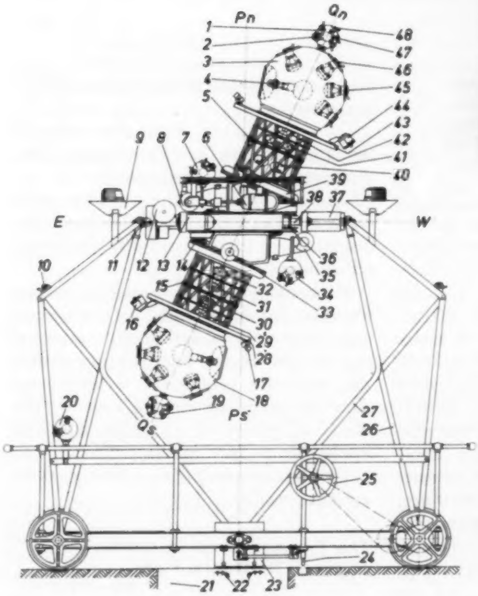
The London Planetarium

The famous German optical firm of Carl Zeiss, formerly of Jena, but now, as Jena is behind the Iron Curtain, located at Oberkochen, Württemburg, has supplied to London, England, the first planetarium to be erected in the British Commonwealth. It was projected as far back as 1936, but war had broken out before it progressed beyond the paper stage and so it has been completed only in the present year. It is mounted at the center of a hemisphere 67 ft diam and contains nearly 200 optical projectors. The inside surface of the dome, on which the stars are shown, is of aluminum sheet, perforated with more than 20 million small holes to provide ventilation and prevent unwanted echoes. The auditorium is air-conditioned and, to keep out dust, is maintained at a pressure 2 psi above that of the external atmosphere. Outside of this aluminum dome is a layer of sound-absorbent material and outside of this again are two concentric hemispheres of concrete, separated by a 3-in. space filled with fiberglas. The outer concrete dome is covered with cork, over which is laid bituminized felt. Finally, the whole is cased in copper sheeting, forming the outside surface. Around the inside of the projection dome, at eye level, is a silhouette of the London sky line.

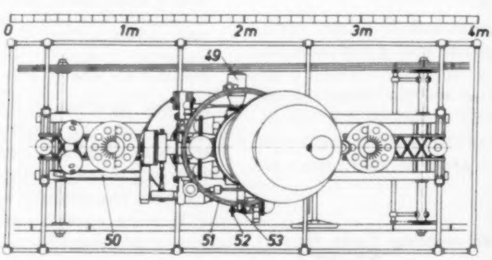
The dumbbell-shaped projector, $13^1/_2$ ft long, is supported on a steel lattice structure mounted on top of an electric lift; it weighs, with the lift, about 6 tons. Between demonstrations it is lowered through the floor to the foyer below, where it can be inspected at close quarters, through glass screens, by the incoming and departing audiences. Each end of the "dumbbell" is a globe of 30-in. diam, fitted with 16 photoengraved star plates grouped round a 1000-watt electric bulb; one globe is for the Northern Hemisphere and the other for the Southern. They are joined by a cylinder of open lattice-



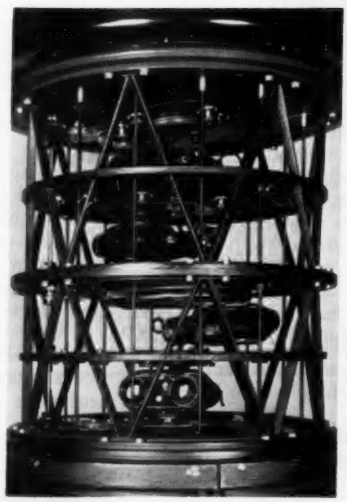
Inside the globe-shaped star projector. Grouped around a 1000-watt bulb are 16 aspherical condensors with photo-engraved star plates behind the lenses.



A steel lattice structure supports the $13^{1}/_{2}$-ft dumb-bell-shaped projector



"Eyelid" shutters gradually obscure the stars as they approach the horizon. The tube half-filled with mercury keeps it horizontal.



Individual projectors for the planets Mercury, Venus, Mars, and Jupiter

work, in which are the projectors for the Sun, Moon, and the five planets which can be seen with the naked eye. In all, the apparatus can project approximately 8900 stars, correctly spaced according to their positions in the sky and accurately graded in brightness. Mechanical "blinkers" are provided which, like artificial eyelids, gradually obscure the light of each star as its projection approaches the horizon, just as true starlight becomes fainter to the observer's eye.

The projector is mounted to give universal movement, all under electronic control. It can also be rotated about its long axis to show the precession of the equinoxes, so that in a few minutes the audience can witness changes which, in the heavens, take nearly 26,000 years to complete. There are supplementary projectors for special purposes; for instance, in addition to viewing the planets as from the Earth, it is possible to show them as they would appear from a point remote from the Earth, with the Earth itself in its correct relative position. By means of another projector, an eclipse of the Sun can be shown; the phases of the Moon can be studied in detail; the paths of the great comets can be traced, in their relation to the night sky at the appropriate dates; and the fanciful patterns of the constellations—Orion, the Great Bear, and such—can be outlined by lines of light connecting the constituent stars. Showers of meteors, and the Aurora Borealis, can be superimposed. The London Planetarium is to date the most advanced realization of the original concept of Professor Dr. Ing. Walther Bauersfeld, Director of Carl Zeiss, of projecting from the center of a fixed hemisphere instead of mechanically rotating a hollow sphere carrying illuminated images of the stars.

Substance in Brief of Papers Presented at ASME Meetings

M. ZANFARDINO
Staff Editor

ASME TECHNICAL DIGEST

Heat Transfer

Engineering Method for Determining a Design Envelope for Air-to-Air Crossflow Heat Exchangers.. ....58—HT-12

By W. T. Shatzer, Douglas Aircraft Company, Inc., Long Beach, Calif. 1958 ASME-AIChE Heat-Transfer Conference paper (multilithographed; available to June 1, 1959).

The problem, "How can you specify the design envelope from which an optimum air-to-air aircraft heat exchanger can be fabricated?" has often been posed. Considering the number of different core types and the innumerable combinations of core geometries (spacing, diameter of tubes, number of fins, and so on) for each core type, it is obvious this problem cannot be solved as stated. However, if the definition of optimum is modified by the addition of the term, "within reasonable engineering limits," a solution can be effected.

This discussion presents a procedure for determining a design envelope for a "near-optimum" heat exchanger. The procedure depends upon:

1 Limitations on the number of heat-exchanger cores that have to be evaluated.

2 Equations for calculating the parameters which represent the performance characteristics of a number of heat-exchanger core types and geometries.

3 Basic equations expressing the relationship between heat-transfer requirements and drag imposed on an aircraft by the heat exchanger.

It must be emphasized that this discussion does not present a procedure for designing heat exchangers. The procedure does specify a reasonable set of dimensions and performance characteristics from which a proper heat exchanger can be constructed. With modification, the procedure can also be used to roughly size heat exchangers during the preliminary phases of cooling-system design, and evaluate and compare competing heat-exchanger designs.

Numerical and Machine Solutions of Transient Heat-Conduction Problems Involving Melting or Freezing ....58—HT-16

By W. D. Murray, Assoc. Mem. ASME, Burroughs Corporation, Paoli, Pa.; and Fred Landis, Assoc. Mem. ASME, New York University, New York, N. Y. 1958 ASME-AIChE Joint Heat-Transfer Conference paper (multilithographed; available to June 1, 1959).

Means for solving the problem of one-dimensional heat conduction with melting or freezing are considered in this paper. A review of previously published analytic techniques reveals the limitations of such techniques. Numerical methods have been reported in the literature, but the previously reported numerical methods do not combine an accurate, continuous description of temperatures in the material and of fusion-front motion, an ability to handle a variety of initial and boundary conditions, and ease of computation.

Two new numerical methods, applicable to digital and analog computation, are developed in the paper. Sample problems using these and the more conventional numerical technique are solved. An evaluation of the methods and recommendations on areas of application are included.

The Design of Heating Coils for Storage Tanks..........58—HT-1

By David Stuhlberg, The Procter & Gamble Company, Cincinnati, Ohio. 1958 ASME-AIChE Joint Heat-Transfer Conference paper (multilithographed; available to June 1, 1959).

Thermal considerations for designing heating coils for storage tanks are given, and certain phases of physical design are noted.

There are a number of different design cases and it is necessary to determine the proper one for a particular application. For example, coils are sometimes sized to maintain a tank at a constant temperature. At other times they are sized to reheat, in a stipulated time, a tank that has been permitted to cool. This case is complicated if the stock partially freezes on cooling.

The case for a coil inside the tank and the case if external coils are required are considered for the steady state.

Cases are given for the unsteady state when stocks remain liquid, or form self-insulation, or partially solidify but do not self-insulate.

Methods for calculating heat losses, formulas for determining the coil area, and a discussion of various factors affecting the coil layout and location within the tank are presented. Experimental data are given supporting some of the material presented. Results may be applicable in part for other cases, such as process or cooling coils, although these are not specifically covered.

The Pressure Drop of Condensing Steam in Horizontal Pipes........ ....58—HT-2

By R. J. Dunn and D. Stuhlberg, The Procter & Gamble Company, Cincinnati, Ohio. 1958 ASME-AIChE Joint Heat-Transfer Conference paper (multilithographed; available to June 1, 1959).

A new equation for computing the pressure drop of condensing steam in horizontal pipes and experimental data supporting it are presented in this paper. This new relationship is derived from the Fanning equation if the following assumptions are used:

1 The heat flux is constant over the entire length of the horizontal pipe. The pipe could be in the form of a tank coil or tube of a heat exchanger. This assumption in turn implies a uniform temperature difference along the coil.

2 The last portion of steam flowing is just condensed at the end of the pipe.

Generalized Correlation of Boiling Heat Transfer...........58—HT-8

By S. Levy, Mem. ASME, General Electric Company, San Jose, Calif. 1958 ASME-AIChE Joint Heat-Transfer Conference paper (in type; to be published in *Trans. ASME;* available to June 1, 1959).

Boiling heat transfer is characterized by the formation of small vapor bubbles

at the heated surface. The bubbles, initially fastened to the surface, rapidly detach themselves from it and grow as they rise through a thin superheated layer close to the heated material. Growth of the bubbles and their escape velocity create large turbulence within the fluid, thus producing the large heat-transfer rates normally associated with boiling heat transfer. It is, therefore, not surprising that correlations of boiling data should be based upon properties of the vapor bubbles.

A generalized equation to describe surface boiling of liquids is derived. The equation correlates all fluid independently of pressure and heating surface-fluid combination.

Good agreement between test results and the derived equation was obtained for pool boiling and nucleate boiling heat transfer of subcooled and vapor-containing liquids.

Free Convection, Forced Convection, and Acoustic Vibrations in a Constant Temperature Vertical Tube..................58—HT-6

By T. W. Jackson, Mem. ASME, W. B. Harrison, and W. C. Boteler, Georgia Institute of Technology, Atlanta, Ga. 1958 ASME-AIChE Joint Heat-Transfer Conference paper (in type; to be published in *Trans. ASME;* available to June 1, 1959).

Experimental studies of heat transfer to air with superposed forced and free convection were reported in a previous paper (see *Trans. ASME*, vol. 80, 1958, pp. 739–745). In studies reported in this paper, the same experimental system was employed, but a complication was added in the form of acoustic vibrations in the flow field. By comparison of the results with and without acoustic vibrations under conditions which were otherwise the same, an effort has been made to determine the effect of acoustic vibrations on heat transfer. The Nusselt modulus, based on the log mean temperature difference, ranged from 17.2 to 50.6; the Graetz modulus, based on the bulk or average temperature of the air, ranged from 40.2 to 1633; and the Grashof-Prandtl *D/L* modulus, based on properties of air at the wall temperature, ranged from 0.967×10^5 to 1.26×10^6.

The results indicated that sound pressure levels below approximately 118 decibels had little effect on the heat-transfer coefficient. Below 118 decibels free convection forces were evident. Above 118 decibels free convection forces were apparently negligible and the effect of sound appeared to be considerable.

Emissivity Measurement of Industrial Surfaces Due to Thermal Radiation.............58—HT-18

By M. N. Aref, Assoc. Mem. ASME, Foster Wheeler Corporation, New York, N. Y. 1958 ASME-AIChE Joint Heat-Transfer Conference paper (multilithographed; available to June 1, 1959).

In the field of physical constants, the measurement of surface emissivity at elevated temperatures has been done by heating up the surface either directly or in a furnace, while keeping the instrument measuring the surface emissivity at room temperature. Apparently, this technique was used due to the lack of a reliable, calibrated high heat-resistant device that would measure the radiant heat flux from the hot surface in the furnace. However, if such a device were available, then the errors involved in the measurement of the surface radiation and the time lag of the earlier instrument can be eliminated. This work presents a new technique in which a calibrated probe radiometer is employed. For the sake of comparison with the new technique, a variation of the earlier technique has been included in this discussion.

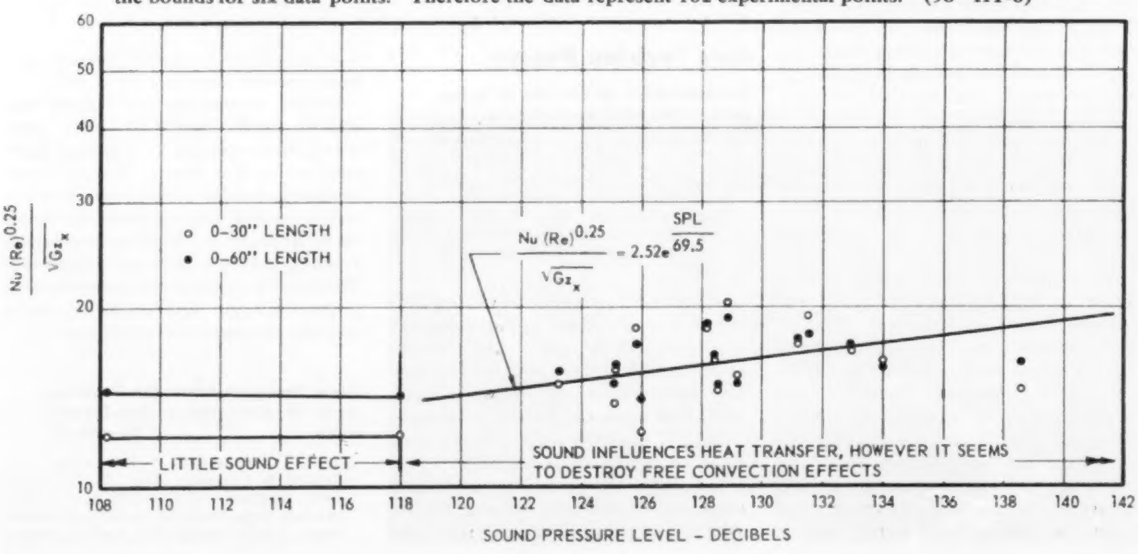
A Note on Latent Heat in Digital Computer Calculations...58—HT-7

By G. M. Dusinberre, Fellow ASME, The Pennsylvania State University, University Park, Pa. 1958 ASME-AIChE Joint Heat-Transfer Conference paper (multilithographed; available to June 1, 1959).

A method for dealing with latent heat in a numerical calculation was proposed by the author in 1945 (see *Trans. ASME*, vol. 67, no. 8, 1945). In the calculation of transient temperature in solids, certain difficulties arise when there is a phase change involving a latent heat or high instantaneous values of specific heat. Such changes occur in melting or freezing or at transition points in metals, notably steel.

This paper outlines methods of calculation which are especially adaptable for digital computers.

Effect of sound pressure level on heat-transfer coefficient. The two plotted points for each sound pressure level are the bounds for six data points. Therefore the data represent 102 experimental points. (58—HT-6)



Transient Response of Heated Air in an Enclosure With Heat Losses..... ....58—SA-3

By W. A. Wolfe, The University of British Columbia, Vancouver, B. C., Canada. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

The transient temperature of well-stirred air in an enclosure with heat losses is investigated. The introduction of the heat capacity of the air results in nonorthogonal eigenfunctions for the differential equation of conduction. A method of determining the coefficients of the eigenfunctions is developed and the transient-air temperature calculated for several values of the heat capacity of the air.

Prediction of Vacuum-Tube Bulb Temperatures..........58—HT-13

By Myron Goldberg, Assoc. Mem. ASME, Sperry Gyroscope Company, Great Neck, L. I., N. Y. 1958 ASME-AIChE Joint Heat-Transfer Conference paper (multilithographed; available to June 1, 1959).

Vacuum-tube reliability is severely impaired if the tube envelope (or bulb) temperature exceeds a certain value. The maximum bulb-temperature rating should never be exceeded. As this maximum bulb temperature is approached, a degradation of reliability must be tolerated or a derated mode of operation must be imposed. Derating more often is a compromise on design characteristics such as weight and space.

Assuming the amplifier designer has certain information available as he conceives his design, the ideal situation would be where he could predict operating temperatures for any combination of the following: (*a*) Any tube; (*b*) any tube position with respect to cooling flow; (*c*) any size channel or configuration; (*d*) any flow of cooling media; (*e*) any fluid used for cooling purposes; (*f*) any temperature (i.e., inlet air, ambient, and such).

This paper is an attempt to provide the electrical engineer or electrical designer with sufficient heat-transfer information to provide some guidance on the bulb-temperature and derating problems. Data on the heat transfer from vacuum-tube amplifiers to a coolant, such coolant being in longitudinal flow along the vacuum tubes, are presented. The results obtained by experiment indicate that a dimensionless correlation, concerning the Stanton, Reynolds, and Prandtl numbers, can be established. Methods of evaluating the heat-transfer coefficient and both average and maximum tube-envelope temperature are presented in the case of a vacuum-tube amplifier containing subminiature triodes.

Transient Heat Conduction in Elliptical Plates and Cylinders........ ....58—HT-10

By E. T. Kirkpatrick, Assoc. Mem. ASME, and W. F. Stokey, Assoc. Mem. ASME, Carnegie Institute of Technology, Pittsburgh, Pa. 1958 ASME-AIChE Joint Heat-Transfer Conference paper (in type; to be published in *Trans. ASME;* available to June 1, 1959).

Equations governing the problem of heat conduction in a long elliptical cylinder were published by N. W. McLachlan in 1945. These equations included the solution for the case of a cylinder with a uniform initial temperature, subject to a sudden temperature change at the outer surface of the cylinder. This paper describes the numerical evaluation of McLachlan's solution by the use of a digital computer. The numerical evaluation of the solution requires the zeros of certain Mathieu functions, the values of the functions at the zeros, and the evaluation of integrals involving them. Tables of the temperatures in cylinders with eccentricities of 0.6, 0.7, and 0.9 are given.

Transient Heat Transfer for Laminar Forced Convection in the Thermal Entrance Region of Flat Ducts..... ....58—HT-3

By Robert Siegel, Assoc. Mem. ASME, and E. M. Sparrow, Assoc. Mem. ASME, National Advisory Committee for Aeronautics, Lewis Flight Propulsion Laboratory, Cleveland, Ohio. 1958 ASME-AIChE Joint Heat-Transfer Conference paper (in type; to be published in *Trans. ASME;* available to June 1, 1959).

Transient heat-transfer considerations are becoming more significant in the design of control systems involving heat-exchange devices. This is especially true in the case of nuclear reactor systems where positive control must be assured, and where the reactor kinetics may be dependent on the dynamics of the heat-exchange system.

In the analysis of such heat-transfer systems, it is common to focus attention on a typical element in heat-exchange equipment; for example, a single heated channel and its bounding walls. Previous analyses in channels have generally been built upon a one-dimensional model, that is, the variations of velocity and temperature over the channel cross section have been neglected. Further, most of the work has been carried out for specific types of temperature variations with time.

An analysis is made in this paper for transient laminar heat transfer in the thermal entrance region of a flat duct (parallel plate channel) whose bounding surfaces are subjected to an arbitrary time variation of temperature or of heat flux. Initially, the system may be either in an already established steady-state heat-transfer situation, or else, the fluid and duct walls may be at the same uniform temperature. The velocity distribution in the flow is taken to be fully developed and unchanging with time. The solution for arbitrary time-dependent conditions is obtained by generalizing the thermal response to a unit step change in wall temperature or in wall heat flux. This step-function response is found by using the method of characteristics. Heat-transfer results are presented as simple analytical expressions. The time required to achieve steady state after a unit step is also given. Working formulas are summarized at the end of the paper.

Gas Turbine Power

Determination of Erosion in Turbojet Fuel Nozzles by Radiochemical Techniques............58—SA-55

By H. R. Hazard, Mem. ASME, and P. Gluck, Battelle Memorial Institute, Columbus, Ohio; and R. W. Tate, Delavan Manufacturing Company, West Des Moines, Iowa. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

In turbojet fuel nozzles cavitation erosion is aggravated by high-temperature operation. These nozzles are precision devices which accurately meter fuel flow over wide pressure ranges, while maintaining an optimum pattern. Excessive erosion of metering parts may therefore cause unsatisfactory performance.

In order to design fuel injectors, it is necessary to take into account the environmental temperatures, pressures, and fuel characteristics as well as nozzle configuration and materials.

Erosion in turbojet fuel nozzles was studied using irradiated nozzle parts which were operated in a special high-temperature flow bench. Engine conditions were simulated, and eroded material was recovered and measured by radiochemical analysis. Wear rates as low as 1 microgram per hr were determined. The erosion resistance of numerous fuel-injector designs was evaluated under extreme environmental conditions.

Some Thoughts About the Development of Automotive Gas-Turbine Units.................58—SA-26

By A. T. Bowden and W. Hryniszak, C. A. Parsons & Company, Ltd., Newcastle-on-Tyne, England. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

Compared with the present-day multicylinder piston engine coupled to the driving wheels through a complicated transmission consisting of a fluid drive working in conjunction with a mechanical gear and the final drive, the simplicity of the gas-turbine unit is striking. As a high-speed turbomachine such a unit is far more suitable for large "surplus-power" driving conditions than a piston engine where such power can only be obtained by a larger displacement due to either larger or more cylinders and a higher speed.

In addition, a gas-turbine unit can show all the advantages gained by introducing a fluid drive for transmitting the power of the piston engine to the wheels of the vehicle without the complications involved. The fact, that temperature is added as another variable to pressure and mass flow, permits a larger flexibility of the gas-turbine unit to meet vehicle requirements, provided its components are properly chosen, arranged, and designed. The additional advantage of a greatly improved positive and negative-torque behavior at a reduced outlay in fuel under accelerating, idling, and decelerating conditions is obtained without additional means, such as a clutch and/or free wheel to cut out the effect of the lack of mechanical connection between pump and turbine in cases where motor braking is required.

These advantages of a gas-turbine unit should be assessed in the light of increases both in density and speed of traffic which lead to automatic fluid drive as a means of relieving the driver who has to cope with such conditions.

Design and Development of a Supercharger for a Pressure-Fired Boiler ....58—SA-25

By R. C. Reisweber, Assoc. Mem. ASME, and J. R. Shields, Elliott Company, Jeannette, Pa.; and J. W. Glessner, Assoc. Mem. ASME, Solar Aircraft Company, San Diego, Calif. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

The supercharged boiler cycle is attractive for marine propulsion in that it offers considerable size and weight saving over a conventional steam cycle. In this cycle the supercharger may be designed in conjunction with the boiler to produce external power or to operate self-sustaining with no net power output.

A self-sustaining gas-turbine supercharger is a particularly attractive method of supercharging. The supercharging compressor is driven by an integral gas turbine utilizing energy from boiler exhaust gas. The supercharger supplies no output power, and is a complete unit in itself with no connection to output shaft. Since the gas turbine supplies only enough power to drive the compressor, inlet temperatures are low and critical materials are unnecessary. Exhaust temperature is also low, so that an economizer is not necessary to utilize available energy. Efficiencies of compressor and gas turbine are not critical. Control of the cycle is accomplished easily by bypassing gas around the turbine.

Features of mechanical and thermodynamic design of an axial-flow supercharger for a pressure-fired boiler are presented. The 11-stage axial-flow compressor is designed to supply 40,000 cfm air at a pressure ratio of 4.5, with inlet conditions 14.7 psia, 100 F, and is required to operate efficiently over a wide speed range. Power required, 6100 hp, is furnished by integrally cased two-stage gas turbine taking boiler exhaust gas at 61.2 psia, 815 F. Thermodynamic performance of the supercharger as determined by shop test is presented.

The Measured and Visualized Behavior of Rotating Stall in an Axial-Flow Compressor and in a Two-Dimensional Cascade.....58—SA-20

By Gino Sovran, General Motors Corporation, Detroit, Mich. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

The technique of smoke-flow visualization has been used to show clearly the action of the flow field upstream of a single rotor during rotating stall. The flow processes on the blades and in the blade passages of a stationary compressor cascade also have been observed using the same technique.

An audio method of detecting rotating-stall patterns has been developed and has indicated that some compressor operating conditions at which no periodic flow disturbance was previously thought to occur actually contained rotating-stall patterns whose number of stalled regions changed very quickly.

The absolute speed of rotation of a stall zone was reduced to zero and its over-all shape clearly outlined by means of smoke visualization. The qualitative results of all these investigations have given a good physical picture of the rotating-stall phenomenon.

Severe reverse flows were found to exist during rotating stall and these caused the formation of reversed flow regions extending upstream of a blade row. Furthermore, the distortions of the flow field in the vicinity of a blade row were found to be of such large magnitude that it does not seem likely that they can be described adequately by any linearized theory.

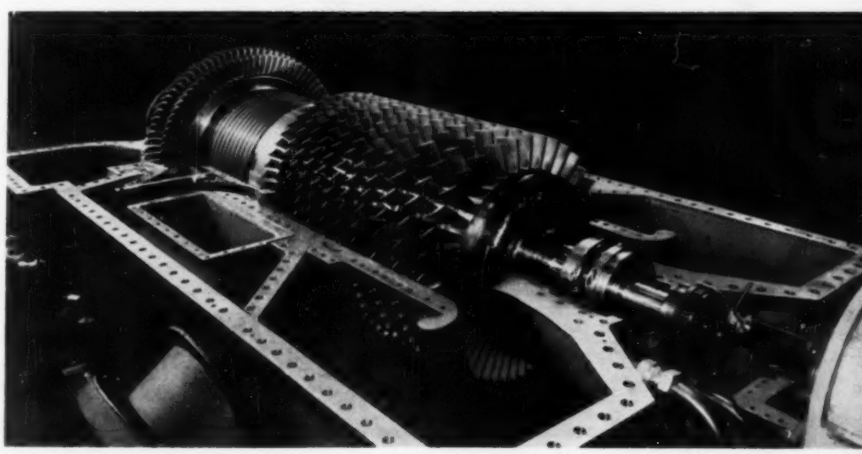
Quantitative investigations were made into the effects of guide-vane turning and axial position on the rotating-stall characteristics of an axial-flow-compressor rotor. The absolute direction of the fluid entering such a configuration was found to affect nearly all facets of rotating-stall behavior.

Stage Performance and Radial Matching of Aerial Compressor Blade Rows...........58—SA-21

By Jeffrey Watkins, Mem. ASME, Solar Aircraft Company, San Diego, Calif. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

In the early days of the employment of axial compressors in gas turbines, average stage pressure ratios no greater than 1.150 were utilized. For aircraft applications it was of prime importance, however, to reduce the weight and size of the engine, and so it was necessary to raise the attainable stage pressure ratios and,

Supercharger for a pressure-fired boiler with casings removed from upper half (58—SA-25)



at the same time, obtain higher through flows per unit of frontal area. This was made possible by not only an improved understanding of the axial matching of the compressor stages, but also by more effective radial matching of the stationary and rotating blade rows comprising the stage.

The transonic compressor at least proved that rotors could be designed to operate quite efficiently at these Mach numbers, providing careful attention was paid to the details of the design. Possibly the greatest virtue of this type of compressor is that it enables the middle and rear stages of a multistage machine to be designed to produce much higher pressure ratios without overloading, and without the necessity of increasing the diameter. Such compressors are operating today quite efficiently (85 per cent isentropic efficiency (η) or thereabouts at design point) with mean stage pressure ratios of 1.250 and flows per unit of frontal area of 30 lb/sec/sq ft or more. Single stage transonic units producing pressure ratios up to 1.800 are also being used today for small shaft engine applications, requiring relatively low flows per unit of frontal area.

These advances have been made possible by an improved understanding of the mechanics of compressor stage operation, but much still remains to be accomplished in this field.

This paper aims to present practical hypotheses concerning the nature of the flow between the blades, and deals with design techniques in relation to this flow.

In addition, some elements of two-dimensional cascade data and a discourse on practical secondary flows are presented.

Management

Technical Data on Border-Punched Cards................58—SA-27

By Gunther Cohn, Mem. ASME, The Franklin Institute, Philadelphia, Pa. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

A versatile card catalog has been devised to serve as a readily accessible store of technical data. With over 100 bits of information per card, it is much more useful than a mere reference file.

Hand-sorted cards were chosen because they are easy to use and permit cross-reference in many ways. Such cards are border-punched to allow selection of key data by needle sorting. The file consists of 5 in. × 8 in. cards, with one card for each discrete item.

Convenient features were achieved by use of the various tricks of the trade on a card of new design. For example, it was apparent that space would not permit direct sorting (one item per hole) of all data. Hence capacity was enlarged by use of more elaborate sorting methods (shallow, deep, and intermediate notches) for data that are sorted only rarely. To prevent an operator with a thin memory from erring, the meaning of notches is printed on the borders and a Guide with full instructions for use and explanations of all entries accompanies the file.

Benefits of such a file to designer and searcher are obvious: they will have at their fingertips a full record of previous ideas. Furthermore, supervisor and analyst can determine custom, know-how, and trend.

An example of such a file is the Catalog of Ordnance fuzes and their explosive components. Each card contains technical data on the front and a sketch on the back. The Catalog is unique in several ways:

1 It is one of the first technical compilations. Specifically, it consists of technical and military fuze data.

2 It has complete coverage. A joint Army, Navy, and Air Force venture, it lists all standard and developmental items.

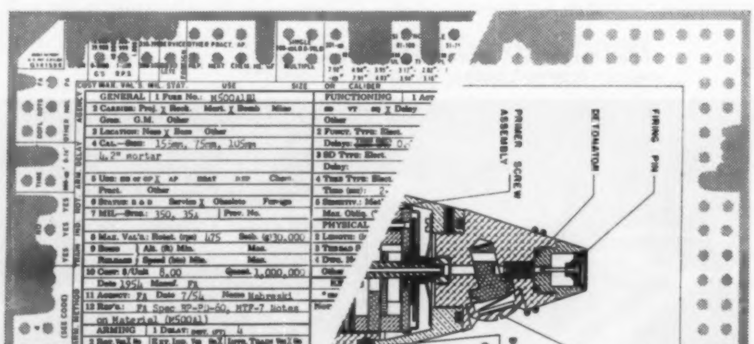
3 It contains detailed data. By specifying design and performance characteristics, it is an actual data source as opposed to a finding aid for such data.

4 It permits rapid data selection. While edge-punched cards have been employed in business practice for several years, their use for recording technical information is recent. They are second in speed only to electric machines, yet require no special equipment.

5 It is available where needed. Multiple copies, produced by photo-offset printing and gang notching, permitted distribution to all agencies concerned.

It is certain that by aiding design, experiment, and administration, this method of recording technical data will find ever increasing favor in other technologies. In many fields of engineering and science, such a catalog is the best means for coping with the ever growing amount of data.

Border-punched card contains technical data on the front and a sketch of fuze on the back (58—SA-27)



A Blueprint for the Storage and Retrieving of Coded Mechanical Engineering Data.......58—SA-6

By E. G. Gilbo, Custom Mechanical Parts Manufacturing, Chicago, Ill. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

A manufacturing concern making several hundred items, mainly custom mechanical sealing devices, was in need of a reliable "memory reference." It demanded a system which could provide a ready reference to all products designed in the past. This system would indicate

the environment in which a particular seal operated, which seals worked successfully, which materials and designs were used to overcome problems presented by high speeds, temperatures, pressures, and such.

A firsthand account is given of the way in which electronic data-processing machines and a code system fulfill industry's urgent need for such an economic and efficient reference system which will make readily available the necessary documentary and product-file information needed for design, research development, and standardization decisions.

Electronic data-processing machines promise a time and money-saving means of attaining this end and should be of great value to other industries, engineering organizations, and research programs.

Engineer-Retention.....58—SA-45

By J. D. Staley, American Management Association, New York, N. Y. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

It has been fashionable for some years to complain about shortages of engineers, scientists, and professional people. Companies are setting goals of "x" or "y" engineers to be recruited, while colleges and technical institutes are warning business that they (the educators) cannot possibly train enough men to meet the demand. Some firms, who seem to be adequately staffed, are looking for an extra man, the "rainy-day" engineer, because they heard all the talk about their being hard to get. In some cases, as much as half a company's requirements were for filling new jobs. Perhaps 50 per cent, however, were for jobs which were opened due to turnover. One company is reported to have spent over $900,000 recruiting and relocating 193 engineers, but in the same period lost 134 to other companies—scoring a net gain of only 59 men.

In the current lull in industrial activity, with car loadings down, new orders at a low ebb, and sales dollars hard to come by, some companies have placed somewhat less emphasis on these problems. They'll be with them again, however, with any forthcoming upswing in industrial indexes.

Concepts of Job Assignment in the Project-Type Engineering Department.................58—SA-47

By C. H. Crosby, Mem. ASME, Arcadia, Calif. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

Personnel administrators have devised and inaugurated various effective plans for placing engineers into jobs fitted to their qualifications. Once a man is on the job, however, the assignment of specific tasks is often the result of a thoughtless selection of job personnel that can become quite expensive in the performance of the detail design work.

One of the greatest needs in small engineering companies and in the project-type engineering departments of large organizations is to bring about the placement of men in specific assignments so that the optimum benefit to the company will result from their efforts. Since engineers are highly trained specialists, it is imperative that their particular abilities be used properly in a harmonious environment. Misassignments waste time and cost money.

By placing men on jobs that they can perform well in harmonious environment, and surrounding them with operation methods that will facilitate and enhance their job performance, this important factor of the utilization of human resources will be mutually profitable to employer and employee.

The Orderly and Economic Handling of Engineering Data........ ....58—SA-49

By T. W. Schwartz, Assoc. Mem. ASME, E. I. du Pont de Nemours & Company, Wilmington, Del. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

Information is recorded because it contains data on the success or failure of a given measure of work. The value of the information is enhanced by its effective and efficient storage and retrieval.

How many better designs could have been done or what better methods could have been used if the right information had not only been available but also accessible? How much duplication of engineering effort is the result of failure to consult records? How many times a week is the wheel invented?

Recognizing this problem, a group in the central engineering department of the author's company began a study of documentation—the process of storage and retrieval of engineering information.

The present system of documentation, following conventional lines of information handling—classifications and alphabetical listings, is outlined. Problems encountered in the classification of information are described.

A new documentation principle, concept co-ordination, is discussed.

Lubrication

Role of Petroleum-Base Rust and Corrosion Preventives in Plant Maintenance..........58—SA-70

By R. A. Fitch, Gulf Research & Development Company, Pittsburgh, Pa. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

Billions of dollars are spent annually by industrial research organizations and producers of protective coatings to prolong the useful life of the many forms and compositions of metal at our disposal.

It is generally agreed that rust and corrosion take a tremendous annual toll of valuable machinery and equipment, but too frequently insufficient attention is given to combating and arresting this destruction.

Discussion is presented of the need for a rust and corrosion-preventive program in manufacturing plants. Types of materials available, methods of cleaning, and application to machinery and equipment are reviewed with the aim of reducing maintenance replacement costs. Rust tests are briefly discussed.

A Variational Approach to Lubrication Problems and the Solution of the Finite Journal Bearing........ ....58—SA-54

By D. F. Hays, General Motors Corporation, Detroit, Mich. 1958 ASME Semi-Annual Meeting paper (multilithographed; to be published in *Trans. ASME;* available to April 1, 1959).

Applications of hydrodynamic theory to problems of lubrication are well known. Indeed, the basic equation of hydrodynamic lubrication may be traced back unchanged to 1886 when Osborne Reynolds completed and published his analysis of surfaces in relative motion separated by a lubricant. Yet Reynolds' equation has not been applied to many specific problems due to the difficulty of finding a solution to this nonhomogeneous second-order partial differential equation. Although the one-dimensional solution has proved helpful in understanding the relationships existing between various bearing parameters, it has not proved to be very helpful in a quantitative analysis of the behavior of an actual bearing.

A general method is derived for the solution of the two-dimensional Reynolds' equation. The method is applied to the solution of the full journal bearing of finite width with a continuous film, and design charts are presented which describe the characteristics of this bearing.

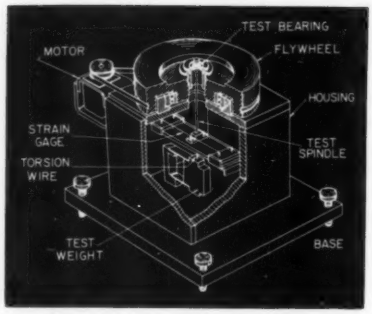
Instruments and Regulators

An Analytic Frequency-Response Solution for a Higher Order Servomechanism With a Nonlinear Control Element . . . . 58—SA-35

By A. M. Hopkin, University of California, Berkeley, Calif.; and K. Ogata, University of Minnesota, Minneapolis, Minn. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

On-off-type control systems designed on the basis of step-input response sometimes exhibit poor frequency-response characteristics. When subjected to periodic inputs, such systems may oscillate at subharmonics of the input frequencies under certain conditions.

When an on-off system is designed with a proportional band, the frequency response of the system must be carefully investigated for the possibility of "jump resonance" and subharmonic oscillations. This is particularly necessary when the system is known to be subjected to occasional periodic inputs.



Isometric drawing of Military Standard 206 friction-torque tester (58—SA-34)

This paper presents an effective method for evaluating the frequency response, both open-loop and closed-loop, for on-off-type feedback control systems with or without proportional bands.

The essential material presented follows the Laplace-transform method suggested by D. Kahn.

It is an extension of the work already reported by K. Ogata.

Antifriction Instrument - Bearing Torque Testing and the Resistance to Motion of Such Bearings . . . . 58—SA-34

By A. B. Asch, Mem. ASME, Asch Equipment Company, Dayton, Ohio. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

The inertial guidance of airplanes and missiles has focused attention on the subject of friction torque of instrument ball bearings. Several years ago the Department of Defense undertook the task of standardizing the rating of the motion-resisting torque of such bearings, and the development of a tester for this purpose. This paper briefly discusses the Mil-Std-#206 torque tester, the interpretation of its results, and some of the frictional properties of instrument antifriction bearings. A cutaway illustration shows the arrangement of configuration of the tester; and a schematic of the system, with the related description, explains the principle of operation. Also a typical torque trace from the tester is reproduced and analyzed.

Applied Mechanics

Response of a Simply Supported Timoshenko Beam to a Purely Random Gaussian Process. 58—APM-1

By J. C. Samuels and A. C. Eringen, Purdue University, Lafayette, Ind. 1958 ASME West Coast Conference of the Applied Mechanics Division paper (in type; to be published in the *Journal of Applied Mechanics;* available to July 1, 1959).

The generalized Fourier analysis is applied to the damped Timoshenko beam equation to calculate the mean-square values of displacements and bending stress, resulting from purely random loading. Compared with the calculations, based on the classical beam theory, it was found that the displacement correlations of both theories were in excellent agreement. Moreover, the means square of the bending stress, contrary to the results of the classical beam theory, was found to be convergent. Computations carried out with a digital computer are plotted for both theories.

Theory of Pitch and Curvature Corrections for the Helical Spring—I (Tension) . . . . 58—APM-11

By C. J. Ancker, Jr., Mem. ASME, Analco Services Company, Chicago, Ill.; and J. N. Goodier, Mem. ASME, Stanford University, Stanford, Calif. 1958 ASME West Coast Conference of the Applied Mechanics Division paper (in type; to be published in the *Journal of Applied Mechanics;* available to July 1, 1959).

The helical spring of round cross section loaded in axial tension is solved. Both pitch and curvature are considered. All deformations and stresses are obtained by a "thin-slice" method which reduces the variables from three to two. The form of the solution is deduced from considerations of symmetry. This knowledge, applied to the equations of the boundary-value problem, produces algebraic equations which are then solved.

Theory of Pitch and Curvature Corrections for the Helical Spring—II (Torsion) . . . . 58—APM-9

By C. J. Ancker, Jr., Mem. ASME, Analco Services Company, Chicago, Ill.; and J. N. Goodier, Mem. ASME, Stanford University, Stanford, Calif. 1958 ASME West Coast Conference of the Applied Mechanics Division paper (in type; to be published in the *Journal of Applied Mechanics;* available to July 1, 1959).

The helical spring of round cross section loaded by an axial twisting moment is solved. Both pitch and curvature are considered. All deformations and stresses are obtained by a "thin-slice" method which reduces the variables from three to two. The method is described in a previous paper, ASME paper No. 58—APM-11. The form of the solution is deduced from considerations of symmetry. This knowledge, applied to the equations of the boundary-value problem, produces algebraic equations which are then solved.

A Theory of Elastic, Plastic, and Creep Deformations of an Initially Isotropic Material Showing Anisotropic Strain-Hardening, Creep Recovery, and Secondary Creep . . . . 58—APM-17

By J. F. Besseling, Stanford University, Stanford, Calif. 1958 ASME West Coast Conference of the Applied Mechanics Division paper (in type; to be published in the *Journal of Applied Mechanics;* available to July 1, 1959).

Stress-strain relations are given for an initially isotropic material, which is macroscopically homogeneous but inhomogeneous on a microscopic scale. An element of volume is considered to be composed of various portions, which can be represented by subelements showing secondary creep and isotropic work-hardening in plastic deformation. If the condition is imposed that all subelements of an element of volume are subjected to the same total strain, it is demonstrated that the inelastic stress-strain relations of the material show anisotropic strain-hardening, creep recovery, and primary and secondary creep due to the nonuniform energy dissipation in deformation of the subelements. Only quasi-static deformations under isothermal conditions are considered. The theory is restricted to small total strains.

Pitch and Curvature Corrections for Helical Springs......58—APM-10

By C. J. Ancker, Jr., Mem. ASME, Analco Services Company, Chicago, Ill.; and J. N. Goodier, Mem. ASME, Stanford University, Stanford, Calif. 1958 ASME West Coast Conference of the Applied Mechanics Division paper (in type; to be published in the *Journal of Applied Mechanics;* available to July 1, 1959).

The tension and torsion helical springs of round cross section have been analyzed by a "thin-slice" method. The effects of both curvature and pitch are included. The results of this analysis are given and discussed in this paper. Stresses, deflections, curvature changes, diametral contractions, and coupling effects are included.

Petroleum

Company-Wide Standardization—An Engineering Viewpoint.............................58—PET-1

By J. Zaba and H. Schaefer, Pan American Petroleum Corporation, Tulsa, Okla. 1958 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1959).

The mechanics of establishing equipment standards in the Pan American Petroleum Corporation are described.

The first step in the program was the selection of the phases of operations in which standardization provided the greatest operating savings and efficiency. It was decided that the standardization effort should proceed along three lines:

1 Standardization of facilities, which includes tank batteries and treating facilities layouts, well-pumping installations, compressor and plant installations, and electrical transmission facilities.

2 Standardization of arrangement of equipment, such as methods of piping separators, treaters and other equipment, arrangement of valves and fittings in Christmas trees, and arrangement of electrical equipment on pumping wells.

3 Standardization of certain items of equipment, methods of design, use of equipment, and materials as acceptable for use. Equipment standardization would involve the selection of equipment based either on engineering specifications or on selection of certain types and makes of acceptable equipment.

ASME TRANSACTIONS

The September, 1958, issue of the *Transactions of the ASME*, which is the *Journal of Applied Mechanics* (available at $1 per copy to ASME member; $1.50 to nonmembers), contains the following papers:

Ducted Fan Design Theory, by C. G. Van Niekerk. (58—A-4)

Effect of Spin on a Rolling Elastic Sphere, by K. L. Johnson. (58—A-5)

Effect of Tangential Contact Force on a Rolling Elastic Sphere, by K. L. Johnson. (58—A-7)

Vibration of a String Having Uniform Motion, by F. R. Archibald and A. G. Emslie. (58—APM-7)

Synthesis of Four-Bar Mechanism, by J. Hirschhorn. (58—A-2)

Natural Forcing Functions in Nonlinear Systems, by T. J. Harvey. (58—A-6)

Kinematic Drift of Single-Axis Gyroscopes, by R. H. Cannon, Jr. (57—A-72)

Co-Ordinates Which Uncouple Equations of Motion, by K. A. Foss. (57—A-86)

Some Shock Spectra Characteristics, by Y. C. Fung and M. V. Barton. (58—APM-5)

Coupled Vibrations of Thin-Walled Beams, by J. M. Gere and Y. K. Lin. (57—A-26)

Timoshenko Beam Equation for Short Pulse-Type Loading, by H. J. Plass, Jr. (58—APM-3)

Nonaxial Bending of Ring Plates of Varying Thickness, by H. D. Conway. (57—A-92)

Transverse Vibrations of Rectangular Orthotropic Plates, by N. J. Huffington, Jr., and W. H. Hoppmann II. (57—A-85)

Contact Stresses Under Pressure and Twist, by M. Hetényi and P. H. McDonald, Jr. (57—A-95)

Stress-Strain Relations for Simple Model of Granular Medium, by H. Deresiewicz. (57—A-90)

Plane Stress Solution of Elastic, Perfectly Plastic Wedge, by P. M. Naghdi. (57—A-40)

Brief Notes

Effect of Tensile Plastic Deformation on Yield Condition, by L. W. Hu and J. F. Bratt

Frequencies of Uniform Beams With Additional Masses, by J. Haener

Integrals for Toroidal Shells Subjected to Pressure, by G. D. Galletly

Analyzing Bending Effects in Toroidal Shells, by G. D. Galletly

Effect of Magnetic Field on Forced Convection Heat Transfer, by R. Siegel

Discussion

On previously published papers, by J. L. Cutcliffe and H. S. Heaps; M. E. Lunchick and R. D. Short, Jr.; P. Shuleshko; and J. F. Osterle, Y. T. Chou, and E. A. Saibel

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COMMENTS ON PAPERS

Management and Engineering in the Age of Automation

Comment by Vincent F. Caputo[1]

The opportunity to comment on this paper[2] is appreciated. It is most certainly thought provoking and I am personally in full accord with this particular approach to the real problem.

The question, which I generally refer to as "Supply Mobility," has been engaging my attention for some time. Monumental improvements in operations have been made within the last few years in particular areas of the many segments that make up the flow of supplies. Individual segments such as warehousing, packaging, transportation, stock control, and the like have been improved on a piecemeal basis and this has resulted in an over-all improvement in the supply system. However, I am now of the firm opinion that additional major improvements in supply mobility will come about as a result of integrating these various segments into a system which encompasses the full range of operations involved in moving supplies from point of production to ultimate consumer.

Not necessarily a single uniform system, but perhaps a series of systems to meet different operational aspects that are sufficiently compatible to smoothly mesh with each other at points where one may come into contact with another. To illustrate: The system for the emergency supply of an aircraft spare need not be the same as that for the routine replenishment of a convenience item, but the two systems should be such that they can both be handled at a common point in the supply line without either interfering with the other.

This process of integration becomes increasingly more difficult as the variation in numbers of different items becomes more complex and the conditions to be met become less and less predictable.

The author recognizes this as a basic approach to further improvements and I am in complete accord with his ideas that automation in the field of materials handling is primarily a matter of systems engineering rather than complete automatic mechanization of individual segments of a system. For example, what advantage is gained by saving manpower through a highly mechanized packaging line if the packaging has to be removed to meet a particular condition that may exist at a point further along in the supply line?

[1] Office Assistant Secretary of Defense, Supply and Logistics, Pentagon, Washington 25, D. C.

[2] Allan Harvey, "Management and Engineering in the Age of Automation," Mechanical Engineering, vol. 80, May, 1958, pp. 66–69, condensed from ASME Paper No. 57—A-251.

BOOKS RECEIVED IN LIBRARY

Basic Motion Timestudy
By Gerald B. Bailey and Ralph Presgrave. 1958, McGraw-Hill Book Company, Inc. New York, N. Y. 195 p., 6¹/₄ × 9¹/₄ in., bound. $5. Provides the principles of work measurement and motion identification necessary for the establishment of a system of predetermined motion times that has as its goal universal application. The present volume differs from similar studies by its use of "basic motion" which emphasizes clear-cut end points that may be applied to all body members. Practical procedures and examples are given.

Contracts, Specifications, and Law for Engineers
By Clarence W. Dunham and Robert D. Young. 1958, McGraw-Hill Book Co., New York, N. Y. 550 p., 6¹/₄ × 9¹/₄ in., bound. $7.50. Included is an explanation of the basic principles of the law of contracts; a discussion of the application of these principles to construction contracts in particular, with data on the preparation of specifications; a consideration of the various fields of law of special interest to the engineer. The authors attempt to state legal principles simply and clearly rather than quote extensively from involved court decisions or complicated legal documents.

Elements of Water Supply and Waste-Water Disposal
By Gordon M. Fair and John C. Geyer. 1958, John Wiley & Sons, New York N. Y. 615 p., 6 × 9¹/₄ in., bound. $8.95. Emphasizes the scientific principles underlying engineering applications. The first half of the book deals with the collection and distribution of water and the collection and removal of waste water, while the second half takes up the behavior of natural waters and the treatment of water and waste water. Appendixes include a collection of supplementary problems and tables to simplify computations.

Engineering Problems Manual
By Forest C. Dana and Lawrence R. Hillyard. Fifth Edition. 1958, McGraw-Hill Book Co., Inc., New York, N. Y. 309 p., 6¹/₄ × 9¹/₄ in., bound. $5.50. The author's main purpose is the development through the utilization of the principles of physics and mechanics, of a systematic approach to the analysis of practical engineering problems and the numerical calculations involved in their solutions. This edition includes additional material on compound interest and a new chapter on the art of problem solving.

Exploring the Atmosphere's First Mile
Proceedings of the Great Plains Turbulence Field Program, 1953. Edited by Heinz H. Lettau and Ben Davidson. 1957, Pergamon Press, New York, N. Y. 2 vol., 6¹/₄ × 9¹/₄ in., bound. $20. A report on a series of meteorological experiments performed in Nebraska for the purpose of studying the profiles of wind and temperature in the atmospheric boundary layer. Also studied are the turbulence structure, boundary fluxes of energy,

momentum, and moisture in relation to this layer of air. Volume one contains descriptive papers, while the second volume contains detailed tabulations of experimental data.

Exterior Ballistics of Rockets
By Leverett Davis, Jr., and others. 1958, D. Van Nostrand Co., Inc., Princeton, N. J. 457 p., $7^3/_4 \times 10^1/_4$ in., bound. $8.50. Explains the basic theory of the exterior ballistics of rockets without moving control surfaces. Emphasis is placed on the physical understanding of rocket behavior as well as on the mathematical formulation of the theory. Equations of motion are formulated and solutions are worked out for many different cases. The first portion of the book is concerned with fin stabilized rockets including the force system, the motion during and after burning, the launching process, and the ballistics of rockets fired forward from aircraft. The second portion deals with essentially the same aspects in relation to spin stabilized rockets.

Fatigue of Aircraft Structures
Published 1957 as Special Technical Publication No. 203 by the American Society for Testing Materials, Philadelphia, Pa. $6^1/_4 \times 9^1/_4$ in., bound. $2.75. Six papers dealing with the problems, methods of test, and latest developments in the fatigue testing of aircraft structures. The material contained is of interest to metallurgists and mechanical engineers working with fatigue problems as well as to aircraft designers.

Feedback Control Systems
By Otto J. M. Smith. 1958, McGraw-Hill Book Co., Inc., New York, N. Y. 694 p., $6^1/_4 \times 9^1/_4$ in., bound. $13.50. An advanced text that presents the relationship between the open-loop transient, sinusoidal, or statistical response and the closed-loop transient, sinusoidal, and statistical response. Given one of these responses, the others may be calculated with the methods described. The material contained is divided into four sections dealing with linear analysis, linear synthesis, steady-state nonlinear analysis, and nonlinear synthesis.

Fluid Mechanics for Engineers
By P. S. Barna. 1957, Butterworths Scientific Publications, London, England. 377 p., $5^1/_2 \times 9$ in., bound. $11.50. An introductory text covering fluid statics; perfect and viscous fluids in motion; flow in closed conduits and open channels; fluid metering; dimensional analysis of fluid-flow phenomena; boundary-layer theory; elements of wing theory; flow of compressible fluids; centrifugal and axial pumps and fans; and hydraulic turbines.

Getriebe, Kupplungen, Antriebselemente
Published 1957 as Schriftenreihe Antriebstechnik, Bd. 18, by Friedr. Vieweg & Sohn, Braunschweig, Germany. 293 p., $6^3/_4 \times 9^1/_4$ in., bound. DM 28.80. A group of 14 papers on gears, couplings, and mechanical drives, covering a considerable range of topics: aspects of design; vibration problems; airplane-engine gearing; helicopter rotors; gear shaving; etc.

Grundzüge der Verzahnung
By A. K. Thomas. 1957, Carl Hanser Verlag, Munich, Germany. 271 p., $6 \times 8^1/_2$ in., bound. DM 34. A thorough treatment of the geometry of gears, which contains everything the normal gear designer is likely to require for either involute or cycloidal common forms of gearing. Short sections on tooth loading and on the ratios and efficiencies of epicyclic gears are also included. A notable feature of the book is that the text and the diagrams are attached respectively to the front and back covers so that they can be opened simultaneously to the corresponding parts and be consulted side by side.

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Human Engineering
By Ernest J. McCormick. 1957, McGraw-Hill Book Co., New York, N. Y. 467 p., $6^1/_4 \times 9^1/_4$ in., bound. $8. A study of the adaptation for human use of work equipment, work space and environment, and consumer products. Topics included are illumination, visual displays, color, atmospheric conditions, arrangement of equipment, and the design and arrangement of controls. In addition several chapters deal with various aspects of the human organism and the way in which motor activities are carried out.

The Hypercircle in Mathematical Physics
By J. L. Synge. 1957, Cambridge University Press, New York, N. Y. 424 p., $6^1/_4 \times 9^1/_4$ in., bound. $13.50. Describes a technique for the approximate solution of certain boundary-value problems of mathematical physics. The technique used involves concepts of function-space. Topics studied include: The geometry of function-space without a metric, with a positive definite metric, and with an indefinite metric; the torsion problem; the vibration problem; the Dirichlet problem for a finite domain in the Euclidean plane.

Jahrbuch der Oberflächentechnik, 1958
Fourteenth Edition. Published 1958 by Metall Verlag GmbH, Berlin, Germany. 1164 p., $4^1/_2 \times 5^3/_4$ in., bound. DM 19.50. This annual publication aims to present the latest information available in the technical and patent literature of Germany and other countries concerning the mechanical, chemical, and electrochemical treatment of metal surfaces. In addition to survey articles by specialists on various phases of metal-surface treatment, the book contains data tables, an extensive classified bibliography covering 1956–1957, lists of trade journals and standards, and other useful information.

Logical Design of Digital Computers
By Montgomery Phister, Jr. 1958, John Wiley & Sons, Inc., New York, N. Y. 408 p., $6^1/_4 \times 9^1/_4$ in., bound. $10.50. Describes methods and techniques for the design of general or special purpose computers by use of synchronous circuit components. The book discusses in detail the Veitch Diagram method of simplification of Boolian equations; the difference-equation approach to memory elements; the Huffman-Moore model of digital systems; the complete solutions to flip-flop input equations. A mathematical introduction to Boolian algebra is included.

Numerical Control Systems for Machine Tools
Proceedings of the EIA Symposium, 1957. Sponsored by the Engineering Department of the Electronic Industries Association and published 1957 by Engineering Publishers, New York, N. Y. 106 p., $8^1/_2 \times 11$ in., paper. $6. Preliminary papers examine the basic principles and terminology of numerical control. They are followed by papers providing detailed descriptions of the operation and application of several commercial numerical control systems to machine tools. Also included are analyses of manufacturing costs by both manual methods and automatic numerically controlled methods.

The Preparation of Programs for an Electronic Digital Computer
By Maurice V. Wilkes and others. Second Edition. 1957. 238 p., $6^1/_4 \times 9^1/_4$ in., bound. $7.50. The present edition has been enlarged to offer a general introduction to programming for any computer of the stored-program type. The first part of the book gives practical examples of programming and surveys various types of order codes to be found in digital computers. In addition it discusses input and output, the contents of a library of subroutines, error diagnosis, and advanced methods. The second and third parts deal with the library of subroutines used with the Electronic Delay Storage Automatic Computer.

Rubber Red Book
1957–58 Edition. 1957, Rubber Age, New York, N. Y. 1458 p., $6^1/_4 \times 9^1/_4$ in., bound. $12.50. A revised edition of a standard directory. Included are listings of rubber manufacturers in the United States and Canada, and of suppliers of rubber machinery and equipment, rubber chemicals and compounding materials, laboratory and test equipment, fabrics and textiles, natural and synthetic rubber, reclaimed rubber, and latex. Other features included are descriptions of natural and synthetic rubbers by type and a who's who of the rubber industry.

The Scientific Papers of Sir Geoffrey Ingram Taylor
Vol. 1: Mechanics of Solids. Edited by G. K. Batchelor. 1958, Cambridge University Press, New York, N. Y. 593 p., 7×10 in., bound. $14.50. This volume, which is the first in a series of four, contains all of Taylor's papers on elasticity, plasticity, the properties of metals, and dislocation theory. A number of studies prepared for government agencies are now made generally available for the first time. The three other volumes will be devoted to papers on the mechanics of fluids.

Scientific Societies in The United States
By Ralph S. Bates. Second Edition. 1958, Columbia University Press, New York, N. Y. 297 p., $6 \times 9^1/_4$ in., bound. $6.50. A historical account of the development of scientific and technological societies in America from their beginnings in the eighteenth century to the present. This edition includes a new chapter on the activities of societies since the second world war. The extensive bibliography has been completely revised and contains further sources of information for most of the major and many of the smaller societies.

Sourcebook on Atomic Energy
By Samuel Glasstone. Second Edition. 1958, D. Van Nostrand Co., Inc., Princeton, N. J. 641 p., $6^1/_4 \times 9^1/_4$ in., bound. $4.40. A

revised edition of a widely accepted sourcebook on atomic and nuclear science. It relates the development of the theories explaining the phenomenon of radioactivity and provides a description of the construction and operation of cyclotrons, synchrotrons, and nuclear reactors. A new chapter has been added on nuclear reactors and new discoveries are presented such as the identification of hitherto unknown fundamental particles, the transmutation of new elements, and advances in the use of isotopes.

Surface Active Agents and Detergents

Vol. 2, by Anthony M. Schwartz and others. 1958, Interscience Publishers, Inc., New York, N. Y. 839 p., $6^1/_4 \times 9^1/_4$ in., bound. $17.50. The present volume supplements the material covered in volume one and covers developments during the period 1947–1956. Various sections deal with processes for synthesizing and manufacturing surfactants; special function surfactants and compositions; the physical and colloidal chemistry of surfactants; practical applications of surfactants. The section dealing with applications is quite extensive and deals with the metal and mineral industries, the building and construction industries, the petroleum and chemical processing industries, etc.

Symposium on Determination of Dissolved Oxygen in Water

Published 1958 as Special Technical Publication No. 219 by the American Society for Testing Materials, Philadelphia, Pa. 59 p., $6^1/_4 \times 9^1/_4$ in., bound. $2.25. This collection of five papers deals wih current procedure for the determination of the concentration of dissolved oxygen in water, including both the manual, spot-check methods, and those using instruments providing continuous indication and record. The principal advantages and disadvantages of various procedures and apparatus are studied, and the conditions under which each can most appropriately be applied is indicated. Methods presented include polarographic measurement, the Beckman analyzer, the Hartman and Braun recorder for boiler feedwater, and the Cambridge analyzer.

Symposium on Insulating Oils

Published 1957 as Special Technical Publication No. 218 by the American Society for Testing Materials, Philadelphia, Pa. 39 p., $6^1/_4 \times 9^1/_4$ in., paper. $1.75. The two papers presented are: Evaluation of laboratory tests as indicators of the service life of uninhibited electrical insulating oils; the use of solid and liquid catalysts for the accelerated aging testing of transformer oil. They are concerned with insulating oil for use in transformers and related electrical equipment, with particular reference to the need for adequate test methods to evaluate new oils, oils in service, and reclaimed oils.

Symposium on Nondestructive Testing

Published as Special Technical Publication No. 213 by the American Society for Testing Materials, Philadelphia, Pa., 99 p., $6^1/_4 \times 9^1/_4$ in., bound. $2.75. Papers discussing the latest and most widely used techniques of nondestructive testing and their application to materials inspection. Techniques discussed include radiographic testing, magnetic particle and penetrant testing, and ultrasonic testing.

Symposiums on Railroad Materials: Lubricating Oils

Published 1957 as Special Technical Publication No. 214 by the American Society for Testing Materials, Philadelphia, Pa. 169 p., $6^1/_4 \times 9^1/_4$ in., bound. $4.50. Seventeen papers on lubricating oils, cleaning compounds, fuels, and nondestructive testing methods. About one half of the papers deal with these materials in relation to diesel engines.

Symposium on Titanium

Published 1957 as Special Technical Publication No. 204 by the American Society for Testing Materials, Philadelphia, Pa. 208 p., $6^1/_4 \times 9^1/_4$ in., bound. $4.75. Papers on testing techniques and effects of various heat treatments on the properties and characteristics of titanium and titanium alloys.

Advanced Fluid Mechanics

Vol. 1, by R. C. Binder. 1958, Prentice-Hall, Inc., Englewood Cliffs, N. J. 296 p., $6 \times 9^1/_4$ in., bound. $6.75. Intended as an extension of elementary fluid mechanics this volume is divided into three parts. The first deals with one-dimensional compressible flow, flow with friction and heat transfer, and boundary-layer flow. Part two gives illustrations and applications of the subject matter in the previous section such as fans, pumps, compressors, and turbines. Part three introduces basic unsteady flow features of engineering importance.

Analytical Kinematics of Plane Motion Mechanisms

By Jesse Huckert. 1958, The Macmillan Co., New York, N. Y. 209 p., $7^1/_2 \times 10$ in., bound. $7.75. Vector methods are used throughout this text to define the concepts of motion. Aspects discussed include the nature of motion transfer, displacement and loci, velocities in mechanisms, properties and transfer of accelerators, cams and cam mechanisms, profile-contact mechanisms, and gears and gearing.

Betriebssichere Gleitlager

By Georg Vogelpohl. 1958, Springer-Verlag, Berlin, Germany. 315 p., $6^3/_4 \times 10$ in., bound. 46.50 DM. Intended as a manual on the safe and efficient operation of journal bearings, this book covers practical bearing design, lubricants and the basic laws of lubricating films, bearing capacity, heat transmission and operating temperatures, and bearing materials. There is a separate chapter on thrust bearings. The practical aspect of the book is exemplified by the extensive use of tables and graphs for the presentation of technical data.

Control Engineers' Handbook

Edited by John G. Truxal. 1958, McGraw-Hill Book Co., Inc., New York, N. Y. Various pagings, $6^1/_4 \times 9^1/_4$ in., bound. $18.50. Provides information on components and techniques for use in the design of feedback-control systems. Emphasis is largely on components with physical explanations of how they work, mathematical descriptions of their uses in typical control systems, and techniques for measuring characteristics. Linear transistor circuits, magnetic and thyratron amplifiers, contactors and relays, power supplies, electromechanical actuators, clutches and brakes, hydraulic and pneumatic components, and signal tranducers are treated from a feedback-control engineering viewpoint.

Gas Dynamics

By Ali B. Cambel and Burgess H. Jennings. 1958, McGraw-Hill Book Co., Inc., New York, N. Y. 415 p., $6 \times 9^1/_4$ in., bound. $11. Presents the theory and concepts underlying compressible fluid flow, wave phenomena, and combustion, with particular reference to propulsion fundamentals in terms of the broad system. It includes material pertinent to preliminary design and testing as well as research in almost all areas of high-speed flow. Recent advances such as high-velocity-combustion phenomena are included along with the latest instrumentation techniques.

Heating, Ventilating, Air Conditioning Guide, 1958

Published 1958 by the American Society of Heating and Air-Conditioning Engineers, Inc., New York, N. Y. 1272 p., $6^1/_4 \times 9^1/_4$ in., bound. $12. This revised edition contains additional material in a number of areas, some of which are: A design method for high-velocity air-duct systems; an enlarged section on the heat pump; a simplified presentation of industrial drying principles, calculations, and system design; new data on heat gain through glass block used in skylights; a general revision of the chapter on radiators, convectors, baseboard, and finned tube units; an increased number of codes and standards.

A History of Magic and Experimental Science

Vol. VII and VIII: The Seventeenth Century. By Lynn Thorndike. 1958, Columbia University Press, New York, N. Y. 695 and 808 pages, $5^3/_4 \times 8^3/_4$ in., bound. $10, per vol. These two concluding volumes discuss the development of experimental science during the seventeenth century and its liberation from superstitious conceptions. Among the myriad aspects and names touched upon, detailed consideration is given to Francis Bacon, Descartes, Huygens, and Boyle, as well as to Harvey's theory concerning the circulation of the blood, the publication of the "Principia" by Newton, and the astronomical studies of Galileo.

An Introduction to Automatic Computers

By Ned Chapin. 1957, D. Van Nostrand Co., Inc., Princeton, N. J. 525 p., $6^3/_4 \times 9^3/_4$ in., bound. $8.75. Intended to convey the computer's functions from a business systems point of view, with its uses and limitations. A discussion of major analysis techniques is included, with reference to applications, programming, and operation. Many specific examples are included for purposes of illustration. Appendixes provide extremely detailed data on automatic computers commercially available, including information on the arithmetic and logic unit, the storage unit, and input-output equipment.

Kerbspannungslehre

By H. Neuber. Second Edition. 1958, Springer-Verlag, Berlin, Germany. 226 p., $6^1/_2 \times 9^1/_4$ in., bound. 36 DM. This thorough development of notch-stress theory is devoted to the problem of precise determination of strength and stresses in structural parts. In addition to the technical data interspersed in the text a number of loose, folded graphs and diagrams are provided in a pocket at the back for easy use.

Management for Engineers

By Roger C. Heimer. 1958, McGraw-Hill Book Co., Inc., New York, N. Y. 453 p., $6^1/_4 \times 9^1/_4$ in., bound. $6.75. The fundamentals of business costs are analyzed in relation to their implications for the engineer. Among the aspects discussed are production costs, standards, materials, methods, taxes, insurance, power, equipment, labor, and ethics. An imaginary firm is used to illustrate the principles discussed.

Nuclear Radiation Detection

By William J. Price. 1958, McGraw-Hill Book Co., Inc., New York, N. Y. 382 p., $6^1/_4 \times 9^1/_4$ in., bound. $9. A compilation of basic information on the important nuclear reaction detectors in use today: ionization chambers, the Geiger-Müller, and proportional counters, scintillation detectors, photographic

emulsions, and neutron-detection methods. Included with the description of the detectors is sufficient information on applications to enable the reader to select his own detection equipment and to apply it. In addition, there are chapters on the fundamentals of nuclear physics and on electronic systems for use with radiation detectors.

The Oilman's Barrel
By Robert E. Hardwicke. 1958, University of Oklahoma Press, Norman, Okla. 122 p., $5^1/_2 \times 8^1/_4$ in., bound. $3.75. A short history of the standard oil barrel, the units which make it up, and the legalities connected with it. It contains historical side lights on the petroleum industry in its early years and of the quest for scientific accuracy in gaging oil.

Oil Reservoir Engineering
By Sylvain J. Pirson. Second Edition. 1958, McGraw-Hill Book Co., New York, N. Y. 735 p., $6^1/_4 \times 9^1/_4$ in., bound. $14. The text is divided into two parts. The first deals with static reservoir problems and in particular the determination of the oil in place in a geological reservoir, while the second deals with dynamic problems such as the determination and prediction of pressure, gas-oil ratio, and well-production ratios. Because of the rapid advances in this field this new edition contains only about one third of the material used in the first edition.

ASME BOILER AND PRESSURE VESSEL CODE

Interpretations

The Boiler and Pressure Vessel Committee meets regularly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in Mechanical Engineering.

(The following Case Interpretations were formulated at the Committee meeting June 20, 1958, and approved by the Board on Aug. 18, 1958.)

Annulment of Cases

Case No.	Reasons for Annulment
1209	Specifications SB-75 and SB-111 now included in Section II Addenda
1215	ASA B16.5-1957 now included in Addenda to Sections I and VIII
1232	Essence of Case now included in Par. H-68
1249	Fig. UHA-28.2 now included in Section VIII Addenda
1250	Fig. UCS-28.2 now included in Section VIII Addenda

Case No. 1205-3

(Reopened) (Special Ruling)

(Integrally Forged Vessels)

Inquiry: Under what conditions may special integrally forged unfired pressure vessels be constructed of carbon and alloy steel forgings conforming to specification SA-372 using an allowable stress value equal to one-third of the specified minimum tensile strength of the material?

Reply: It is the opinion of the Committee that forgings complying with SA-372 may be used in the construction of special integrally forged pressure vessels under the rules of Section VIII, Part UF using an allowable stress value of one third the specified minimum tensile strength provided the following additional requirements are met and when so constructed the vessels may be stamped with the Code symbol.

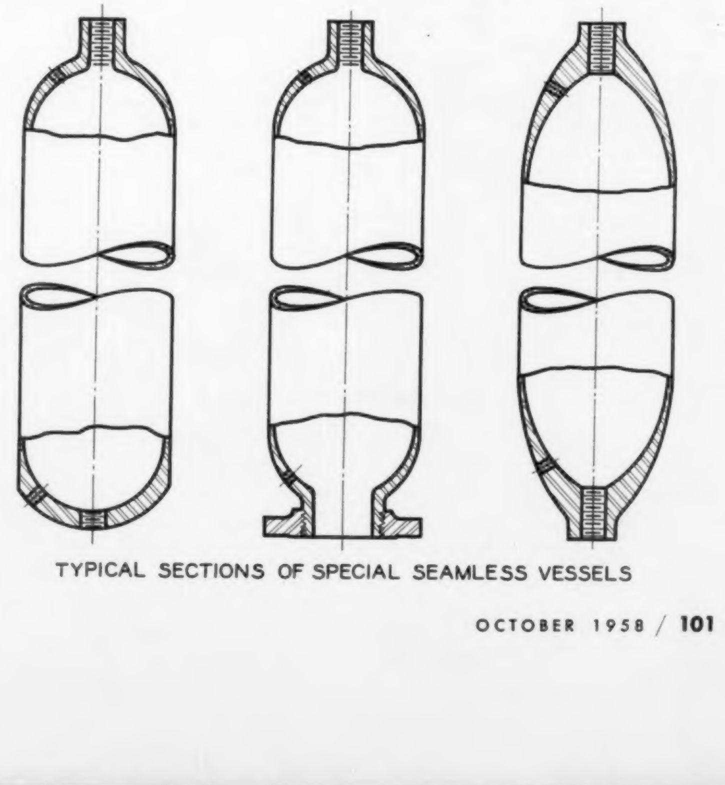
(1) The maximum inside diameter of the shell is 24 in.

(2) The design temperature of the vessel is between minus 20 F and 200 F.

(3) The streamlined design as shown in the sketch incorporates:

(a) No stress raisers such as openings, welded attachments, or stamping on the shell portion.

(b) Integral heads, hot formed, concave to the pressure, and so shaped and thickened as to provide details of design and construction of the center openings which will be as safe as those provided by the rules of the Code; center openings not exceeding 50 per cent of the diameter of the vessel or 3 in. pipe size; other openings in the head not exceeding $^3/_4$ in. pipe size; openings shall



TYPICAL SECTIONS OF SPECIAL SEAMLESS VESSELS

be placed at a point where the calculated stress, without holes, is not more than one eighth of the specified minimum tensile strength.

(c) No welding.

(4) The completed vessel, after all forging operations, is heat treated by one of the applicable methods outlined in SA-372. When oil quenched and tempered, each vessel shall be hardness tested as outlined in UF-31(b)(1)(b).

(5) After heat treatment, each vessel regardless of the type of heat treatment used, is subjected to the magnetic particle test outlined in UF-31(d).

(6) The tensile properties are determined by the testing method outlined in SA-372 using specimens which are representative of each lot and which are selected after final heat treatment.

(7) The vessel is not subject to corrosion on the interior or exterior.

(8) The vessel is not subject to shock or rapid cyclic operation.

(9) The vessel is stamped on the thickened head portion with both the maximum allowable working pressure based on a stress equal to one-fourth the specified minimum tensile strength and also the maximum allowable working pressure based on a stress equal to one-third the specified minimum tensile strength. The words "Case No. 1205" shall be stamped following the latter pressure.

Case No. 1247-1

(Reopened) (Special Ruling)

(Aluminum Alloy 5083)

In the Inquiry, first paragraph, first line, delete the words: "Sheet and plate of."

In the Reply, Part 1, Specifications, add the following sentence: "The mechanical properties of extruded bar, rod or shapes shall be as in Par. 2."

Revise Table 1 to read as shown.

Revise Table in Part 4 Allowable Stresses, to read as shown in Table 2.

CASE NO. 1247-1—TABLE 1

Product	Condition	Thickness, in.	Tensile strength, psi	Yield Strength 0.2 per cent offset, psi	Elongation in 2 in. per cent
Sheet and Plate	Annealed	to 0.750	40,000	18,000	16
	Annealed	0.750–2.000	38,000	16,000	16
	-H113	to 2.000	44,000	31,000	12
Rods, Bars	Annealed	All	38,000	16,000	16
Shapes	-H112	All	40,000	24,000	12

CASE NO. 1247-1—TABLE 2

Product	Condition	Thickness	Metal Temperature Not Exceeding Deg F 100	150
Sheet and Plate	Annealed	to 0.750	10,000	10,000
		0.750–2.000	9,500	9,500
	-H113	to 2.000	11,000	11,000
Rods, Bars	Annealed	All	9,500	9,500
Shapes	-H112	All	10,000	10,000

Case No. 1253

(Special Ruling)

(Leaded Steel Plate and Forgings for Boilers and Unfired Pressure Vessels)

Inquiry: Is it permissible in welded construction conforming to the requirements of the Code to use carbon steel plate and forgings containing 0.15 to 0.35 per cent lead but otherwise conforming to the requirements of specifications SA-285 Grades A, B and C, SA-201 Grades A and B, SA-212 Grades A and B and SA-105 Grades I and II, SA-181 Grades I and II?

Reply: It is the opinion of the Committee that the materials specified in the Inquiry may be used in the construction of the welded pressure vessels and boilers under the rules of the Code provided the following additional requirements are complied with:

(1) The maximum thickness of welds in plate material shall be 2 in. and the maximum thickness of welds in forgings shall be 4 in.

(2) The maximum operating temperature shall not exceed 550 F.

(3) The maximum allowable stress values shall be the same as those given for the comparable specifications without lead.

(4) The qualification of welding procedures and the welders shall conform to Section IX. A separate welding procedure shall be used for these materials.

(5) Overlay or joining by welding of this material with stainless steel or other high alloys is prohibited. These leaded materials shall be welded only with carbon steel filler metals.

(6) Check analysis for lead shall be made from the plate and the part thereof representing the bottom-most point of the ingot as used.

(7) When these leaded steels are used, it shall be so indicated on the data reports and reference made to the Case.

Case No. 1254

(Special Ruling)

(AISI Grade D-319 (Type 316 Modified Stainless Steel))

Inquiry: In order to obtain optimum corrosion resistance, it is sometimes considered desirable to modify the standard chemical composition range of Type 316 stainless steel. For Code construction, will it be acceptable to use a grade designated as AISI D-319 having the following chemical composition:

	PER CENT
Carbon	0.07 max
Magnesium	2.00 max
Silicon	1.00 max
Phosphorus	0.045 max
Sulfur	0.030 max
Chromium	17.50–19.50
Nickel	11.00–15.00
Molybdenum	2.25–3.00

Reply: It is the opinion of the Committee that a steel having a chemical composition as stated in the Inquiry and designated Type D-319 may be used for Code construction under all the rules applicable to Type 316 stainless steel. The allowable stress values for the regular Type 316 shall apply. The qualification of Procedure and Performance in Section IX for Type 316 shall apply.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code . . .

As NEED arises, the Boiler and Pressure Vessel Committee entertains suggestions for revising its Code. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Power Boilers, 1956

TABLE P-6 Revise in accordance with the accompanying stress values. There is no change in the Notes.

PAR. P-102(h)(4) Revise to read:

The film during exposure shall be as close to the surface of the weld as practicable. If possible, this distance shall not be greater than one in. In this paragraph s is defined as the distance from the radiation side of the weld to the source of radiation and f is defined as the distance from the radiation side of the weld to the film. When the ratio s/f is less than 7 to 1, the manufacturer shall satisfy the inspector that the technique employed doing the work is known to be adequate.[1] In all cases when the ratio s/f is less than 7 to 1, the ratio shall be clearly indicated directly on each film or by attaching the information thereto.

PAR. P-340(c)(4)(c) Revise to read:

The space between a rupture disk and the valve should be provided with a pressure gage, tricock, free vent or a suitable tell-tale indicator. This arrangement permits the detection of disk rupture or leakage.

Material Specifications, 1956

The Boiler and Pressure Vessel Committee has approved adding to Section II the following new specification:

SB-315-57T Copper-Silicon Alloy Seamless Pipe and Tube

Unfired Pressure Vessels, 1956

PAR. UG-6 Add a footnote reference, 1, to the title and a new Footnote 1 to read:

[1] The term plate for the purpose of this usage includes sheet and strip also.

PAR. UG-16(d) Revise to read:

If pipe or tube is ordered by its nominal wall thickness, the manufacturing undertolerance on wall thickness shall be taken into account. The next heavier commercial wall thickness may then be used. The manufacturing under-tolerances are given in the several pipe and tube specifications listed in the applicable tables in Subsection C. After the minimum wall-thickness is determined, it shall be increased by an amount sufficient to provide the manufacturing undertolerance allowed in the pipe or tube specification.

FIG. UG-31 Revise abscissa to read:

Design Stress, psi, from Appropriate Table in Subsection C (for Welded Tubes or Pipes Use the Design Stress for Seamless Material).

PAR. UG-45 Revise to read:

The wall thickness of a nozzle neck or other connection shall not be less than the thickness computed for the applicable loadings in Par. UG-22 plus the thickness added for corrosion allowance on the connection and, except for access openings and openings for inspection only, not less than the smaller of the following:

(1) The required thickness (assuming $E = 1$) of the shell (or head) to which the connection is attached plus the corrosion allowance provided in the shell (or head) adjacent to the connection.

(2) The minimum thickness[1] of standard wall pipe plus the corrosion allowance on the connection.

Add a new Footnote 1 to read as follows:

[1] The minimum thickness of all materials is the nominal wall thickness listed in Table 4 of ASA B36.10-1950 less $12^1/_2$ per cent. For diameters other than those listed in the table, this shall be based upon the next larger pipe size.

PAR. UG-46 Change reference to Footnote 1 to Footnote 2 and renumber present Footnote 1 as Footnote 2.

PAR. UG-46(f) Change reference to Footnote 2 to Footnote 3 and renumber present Footnote 2 as Footnote 3.

PAR. UG-127(d)(4) Revise to read:

The space between a rupture disk and the valve should be provided with a pressure gage, try cock, free vent or a suitable tell-tale indicator. This arrangement permits the detection of disk rupture or leakage.

PART UF Delete "Integral" before "Forging" in the title.

PAR. UF-1 Delete "integrally" before "forged" in Line 2.

PAR. UF-5 Revise to read:

UF-5 General (a) Materials used in the construction of forged pressure vessels shall comply with the requirements for materials given in Pars. UG-5 through UG-14, except as specifically limited or extended in (b) and (c) and in Par. UF-6.

(b) The ladle analysis of forgings to be fabricated by welding shall not exceed carbon 0.35 per cent and sulfur 0.05 per cent. However, when the welding involves only minor nonpressure attachments as limited in Par. UF-32, the carbon content shall not exceed 0.50 per cent by ladle analysis. When, by ladle analysis, either the carbon content exceeds 0.50 per cent or the sulfur content exceeds 0.05 per cent, no welding is permitted.

(c) Materials, other than austenitic steels, subjected to a liquid quench and temper heat treatment shall be fabricated without welding or brazing of any kind.

PAR. UF-6 Revise to read:

UF-6 Forgings Vessels, main sections of vessels and other pressure parts shall conform to one of the following:

(a) Forging specifications SA-105, SA-181, SA-182, SA-266, SA-336, SA-350 or SA-372.

(b) One of the specifications listed in Table UCS-23 or Table UHA-23 for plates, seamless pipe or seamless tube when such material is further processed by a forging operation.

PAR. UF-12 Revise to read:

UF-12 General The rules in the following paragraphs apply specifically to vessels or main sections of vessels that are forged from ingots, slabs, billets, plate, pipe or tubes, and shall be used to supplement the requirements for design which are applicable, as given in Pars. UG-16 through UG-55, and those given in Pars. UCS-16 through UCS-67 and UHA-20 through UHA-34. Sections of vessels may be joined by any method permitted in the several parts of the Code except as limited in UF-5(b) and UF-5(c).

Vessels constructed of SA-372 Classes III, IV or V materials must be of streamlined design and stress raisers such as abrupt changes in section shall be minimized. Openings in vessels constructed of liquid quenched and tempered materials, other than austenitic steel, shall be reinforced in accordance with Par. UG-37; Par. UG-36(c)(3) shall not apply.

PAR. UF-13(a) In Line 3 change "by" to "using." Add "except as limited in UF-5(b) and UF-5(c)." in last line, after "Code."

PAR. UF-13(b) In Line 1 revise "an integrally forged" to read "a forged." In Line 5 change "of the" to "at the."

PAR. UF-13(c) Revise to read:

(c) Except for the $3t$ requirements in Par. UG-32(j) the design of the head shall comply with the applicable provisions of Pars. UG-32, UG-33, UG-34 and UA-6.

PAR. UF-25 Add a new paragraph, UF-25, to read:

UF-25 Corrosion Allowance (a) Provision shall be made for corrosion in accordance with the requirements in Par. UG-25.

PAR. UF-26 Revise to read:

UF-26 General The rules in the following paragraphs apply specifically to forged vessels, main sections of vessels and other vessel parts, and shall be used

to supplement the applicable requirements for fabrication given in Pars. UG-75 through UG-84 and UCS-79. For high-alloy steel forged vessels, the applicable paragraphs of Part UHA shall also apply.

PAR. UF-28 Add "Forged" before "Heads" in the title and in Line 1. Change "may be" to "by" in the last line.

PAR. UF-29 Add "Forged" before "Heads" in the title, and change "The" to "Forged" in Line 1.

PAR. UF-30 Revise to read:

UF-30 Localized Thin Areas Forgings are permitted to have small areas thinner than required if the adjacent areas surrounding each has sufficient thickness to provide the necessary reinforcement according to the rules for reinforcement in Par. UG-40.

PAR. UF-31 Revise to read:

UF-31 Heat Treatment (a) *Normalized or Annealed Material* **(1)** After all forging is completed, each vessel or forged part fabricated without welding shall be heat treated in accordance with the applicable material specification. When defects are repaired by welding, subsequent heat treatment may be necessary in accordance with Par. UF-37(b).

(2) Vessels fabricated by welding of forged parts requiring heat treatment shall be heat treated in accordance with the applicable material specification as follows:

(*a*) After all welding is completed, or

(*b*) Prior to welding, followed by stress relieving of the finished weld in accordance with Par. UW-40.

(*c*) When the welding involves only minor non-pressure attachments to vessels having carbon content exceeding 0.35 per cent but not exceeding 0.50 per cent by ladle analysis, requirements of Par. UF-32(b) shall govern.

(b) *Liquid Quenched Material* **(1)** Vessels fabricated by forging material to be liquid quenched and tempered, shall be heat treated in accordance with the applicable material specifications after all forging and repair welding is completed. (Quenching medium must be oil for vessels fabricated from SA-372 material.)

(*a*) After final heat-treatment, such vessels, except those made of austenitic steels, shall be examined by magnetic particle inspection as outlined in ASTM A-275 to detect the presence of quenching cracks on the outside surface of the shell portion and on the inside surface where practicable. A crack which is not removed within the minimum thickness limit of the shell is cause for rejection.

(*b*) After final heat-treatment, liquid quenched and tempered vessels, except those made of austenitic steels, shall be subjected to Brinell hardness tests at 5 ft intervals with a minimum of four readings at each of not less than three different sections representing approximately the center and each end of the heat treated shell. The average of the individual Brinell hardness numbers at each section shall be not less than 10 per cent below nor more than 25 per cent above the number obtained by dividing 500 into the specified minimum tensile strength of the material, and the highest average hardness number shall not exceed the lowest average value on an individual vessel by more than 40. (Other hardness testing methods may be used and converted to Brinell numbers by means of the Table in ASTM E-48.) Reheat treatment is permitted.

(*c*) In the case of austenitic steels, the heat-treatment procedures followed shall be in accordance with Par. UHA-32.

(c) *Non-heat-Treated Material* **(1)** Stress relieving of vessels fabricated by welding of forged parts not requiring heat-treatment shall meet with the requirements of Par. UCS-56.

PAR. UF-32 Revise to read:

UF-32 Welding for Fabrication (a) Vessels constructed of material other than austenitic steel, which has been liquid quenched and tempered shall be fabricated without welding or brazing of any kind.

(b) All welding used in connection with the fabrication of forged vessels or components shall comply with the applicable requirements of Parts UW, UCS and UHA, and Par. UF-5(b) except as modified in UF-32(c).

(c) When the carbon content of the material exceeds 0.35 per cent by ladle analysis, or the sulfur content exceeds 0.05 per cent by ladle analysis, the vessel or part shall be fabricated without welding of any kind except for repairs (See UF-37(b)) and for minor non-pressure attachments. Minor non-pressure attachments shall be joined by fillet welds of not over $^{1}/_{4}$ in. throat dimensions. Such welding shall be allowed under the following conditions:

(1) The suitability of the electrode and procedure shall be established by making a groove weld specimen as shown in Fig. Q-3 of Section IX in material of the same analysis and of thickness in conformance with Table Q-13. Tensile and bend tests shall be made, after any required heat-treatment, as shown in Fig. Q-6 and Fig. Q-7 (Fig. Q-7.1 and Q-7.2) respectively. These tests shall meet the requirements of Par. Q-6 and Q-8 of Section IX. The radius of the mandrel used in the guided bend test shall be as follows:

Thickness of Specimen	Radius of Mandrel (*B*)*	Radius of Die (*D*)*
$^{3}/_{8}$ in.	$1^{1}/_{4}$ in.	$1^{11}/_{16}$ in.
t	$3^{1}/_{2}\,t$	$4^{1}/_{2}\,t + {}^{1}/_{16}$ in.

* Corresponds to dimensions *B* and *D* in Fig. Q-8 in Section IX, and other dimensions to be in proportion.

Any cutting and gouging processes used in the repair work shall be included as a part of the procedure qualification.

(2) Welders shall be qualified for fillet welding specified by making and testing a specimen in accordance with Fig. Q-9(a) and Par. Q-9 of Section IX. Welders shall be qualified for repair welding by making a test plate in accordance with Fig. Q-3 from which the bend tests outlined in Table Q-24 shall be made. The electrode used in making these tests shall be of the same classification number as that specified in the procedure. The material for these tests can be carbon steel plate or pipe provided the test specimens are preheated, welded and post-heated in accordance with the procedure specification for the type of electrode involved.

(3) The finished weld shall be stress-relieved or given a further heat-treatment as required by the applicable specification.

(4) The finished welds shall be examined after final heat-treatment or stress relief by either the magnetic particle or dye penetrant inspection, and found free of defects.

PAR. UF-37 Add a new paragraph, UF-37, to read:

UF-37 Repair of Defects in Material (a) Surface imperfections such as chip marks, blemishes or other irregularities shall be removed by grinding or machining and the surface exposed shall be blended smoothly into the adjacent area where sufficient wall thickness permits thin areas in compliance with the requirements of UF-30.

(b) Thinning to remove defects beyond those permitted in Par. UF-30 may be repaired by welding, only after approval by the inspector. Defects shall be removed to sound metal as shown by acid etch or any other suitable method

of examination. The welding shall be as outlined below:

(1) Material having carbon content of 0.35 per cent or less and sulfur content 0.05 per cent or less (by ladle analysis).

(*a*) The welding procedure and welders shall be qualified in accordance with Section IX.

(*b*) Stress relieving after welding shall be governed as follows:

(*1*) All welding shall be stress-relieved if Par. UCS-56 requires stress-relief, for all thicknesses of material of the analysis being used.

(*2*) Fillet welds need not be stress-relieved unless required by (1) or unless the fillet welds exceed the limits given in Par. UCS-56.

(*3*) Repair welding shall be stress-relieved when required by (1) or if it exceeds 6 sq in. at any spot or if the maximum depth exceeds $^1/_4$ in.

(*c*) Repair welding shall be radiographed if the maximum depth exceeds $^3/_8$ in. Repair welds $^3/_8$ in. and under in depth which exceed 6 sq in. at any spot and those made in materials requiring stress-relief shall be examined by radiographing, the magnetic-particle method, or any alternative method suitable for determining cracks.

(*d*) For liquid quenched and tempered steels, other than austenitic steels, welding repairs shall be in accordance with UF-37(b)(2)(b).

(2) Material having carbon content over 0.35 per cent or sulfur content over 0.05 per cent (by ladle analysis).

(*a*) Welding repairs shall conform with UF-32(c) except that if the maximum weld depth exceeds $^1/_4$ in., radiography, in addition to magnetic particle inspection or dye penetrant inspection shall be used.

(*b*) Welding repairs of materials which are to be or have been liquid quenched and tempered, other than austenitic steels, regardless of depth or area of repairs shall have the affected area radiographed and inspected by the magnetic particle method after final heat-treatment.

Par. UF-38 Add a new paragraph, UF-38, to read:

UF-38 Repair of Weld Defects The repair of welds of forgings having carbon content not exceeding 0.35 per cent by ladle analysis and sulfur content not exceeding 0.05 per cent by ladle analysis shall follow the requirements of UW-38.

Par. UF-45 Revise to read:

UF-45 General The rules in the following paragraphs apply specifically to the inspection and testing of forged vessels and their component parts. These rules shall be used to supplement the applicable requirements for inspection and tests given in Pars. UG-90 through UG-102.

All forged vessels shall be examined as manufacture proceeds, to assure freedom from loose scale, gouges or grooves, and cracks or seams that are visible. After fabrication has passed the machining stage, the vessel body shall be measured at suitable intervals along its length to get a record of variations in wall thickness, and the nozzles for connecting piping and other important details shall be checked for conformity to the design dimensions.

Par. UF-46 Revise to read:

UF-46 Approval by Inspector Surfaces which are not to be machined shall be carefully examined for visible defects such as seams, laps or folds. On surfaces to be machined the inspection shall be made after machining. Regions from which defective material has been removed shall be inspected after removal and again after any necessary repair.

Par. UF-47 Revise to read:

UF-47 Parts-Forgings Identification The inspector shall see that parts-forgings made elsewhere bear the manufacturer's stampings. Should identifying marks be obliterated in the fabrication process and for small parts, other means of identification shall be used.

Par. UF-52 Revise to read:

UF-52 Check of Heat-Treatment and Stress-Relieving The inspector shall check the provisions made for heat-treatment to assure himself that the heat-treatment is carried out in accordance with provisions of Pars. UF-31 and UF-32. He shall also assure himself that stress-relieving is done after repair welding when required under the rules of Par. UF-37.

Par. UF-53 Revise to read:

UF-53 Test Specimens When test specimens are to be taken under the applicable specification, the inspector shall be allowed to witness the selection, place the identifying stamping on them, and witness the testing of these specimens.

Par. UF-54 Revise to read:

UF-54 Tests and Retests Tests and retests shall be made in accordance with the requirements of the material specification.

Par. UF-64 Delete this paragraph and substitute the following, Par. UF-115:

UF-115 General The rules of Pars. UG-115 through UG-120 shall apply to forged vessels as far as practicable. Vessels constructed of liquid quenched and tempered material, other than austenitic steels, shall be stamped on the thickened head, unless a nameplate is used.

Par. UF-65 Delete this paragraph and substitute the following, Par. UF-120:

UF-120 Data Reports A data report giving the heat number or numbers and composition of the metal in the ingot from which the vessel was forged, the test results obtained for the forging, and the dimensions of the vessels shall be furnished by the manufacturer and signed by the inspector and the manufacturer. The purchaser shall be supplied with copies of this data report, properly certified in the number requested.

Par. UF-70 Delete this paragraph and substitute the following, Par. UF-125:

UF-125 General The provisions for pressure-relief devices of Pars. UG-125 through UG-134 shall apply without supplement.

Par. UCS-56(a)(1) Delete reference to Specification SA-301 and revise to read:

. . . SA-217 Grades WC4 and WC5, SA-333 Grade 4, SA-350 Grade LF4, SA-357, SA-387, Grades B, C, D and E, and SA-410 and for . . .

Par. UCS-57 Delete reference to Specification SA-301 and revise to read:

. . . and for each butt welded joint in vessels built of steel complying with Specifications SA-333 Grade 4, SA-350 Grade LF4, SA-353, SA-357, SA-387, Grades D and E, and SA-410 for all plate thicknesses.

Table UCS-23 Under Low-Alloy Steels, delete reference to SA-301 and stress values.

STRESS VALUES TO BE ADDED TO TABLE UNF-23

Spec. No. PIPE AND TUBE	Condition	Specified Tensile Strength, psi	Minimum Yield Strength, psi	For Metal Temperatures Not Exceeding Deg F 100–300	350
SB-315	Annealed	50,000	15,000	10,000	5,000

Par. UNF-6 Delete Footnote 1.

Table UNF-23 Add the accompanying stress values.

Par. UHA-33(c) Revise to read:

All vessels constructed of austenitic chromium nickel stainless steels which are radiographed because of the thickness requirements of Par. UW-11, or for lesser thicknesses where the joint efficiency reflects the credit for radiographic examination of Table UW-12, shall be radiographed following post-heating, if such is performed.

Par. UW-41 Add a new paragraph, UW-41, Sectioning of Welded Joints, to read as follows:

Welded joints may be inspected by sectioning when agreed to by user and manufacturer, but this inspection shall not be considered a substitute for spot-radiographic-examination. This type of inspection has no effect on the joint factors in Table UW-12. The method of closing the hole by welding is subject to approval by the inspector. Some acceptable methods are given in Appendix K.

Par. UW-51(f) Revise to read:

The film during exposure shall be as close to the surface of the weld as practicable. If possible, this distance shall not be greater than 1 in. In this paragraph s is defined as the distance from the radiation side of the weld to the source of radiation and f is defined as the distance from the radiation side of the weld to the film. When the ratio s/f is less than 7 to 1, the manufacturer shall satisfy the inspector that the technique employed doing the work is known to be adequate.[1] In all cases when the ratio s/f is less than 7 to 1, the ratio shall be clearly indicated directly on each film or by attaching the information thereto.

Par. UW-52 Revise to read:

UW-52 Spot Radiographic Examination of Welded Joints

Note: Spot radiographing of a welded joint is recognized as an effective inspection tool. The spot radiography rules are also considered to be an aid to quality control. Spot radiographs made directly after a welder or an operator has completed a unit of weld proves that the work is or is not being done in accordance with a satisfactory procedure. If the work is unsatisfactory, corrective steps can then be taken to improve the welding in the subsequent units, which unquestionably will improve the weld quality.

Spot radiography in accordance with these rules will not insure a fabrication product of predetermined quality level throughout. It must be realized that an accepted vessel under these spot radiography rules may still contain defects which might be disclosed on further examination. If all radiographically disclosed unacceptable weld defects must be eliminated from a vessel, then 100 per cent radiography must be employed.

(a) Vessels and parts of vessels that have longitudinal and circumferential welded joints that are not radiographed full length, and which are required to be for theirspot examined by other sections of the code, shall be examined locally by spot radiographing as provided herein.

Delete present Pars. (b) and (c).

Add new Pars. (b) and (c) as follows:

(b) Minimum Extent of Spot Radiographic Examination

(1) One spot shall be examined in the first 50 feet of welding in each vessel and one spot shall be examined for each additional 50 feet of welding or fraction thereof, except that when identical vessels, individually of less than 50-foot seam length, are being fabricated under the rules of this paragraph, 50-foot increments of welding may be represented by one spot-examination.

(2) Such additional spots as may be required shall be selected so that an examination is made of the welding of each welding operator or welder. Under conditions where two or more welders or welding operators make weld layers in a joint, or on the two sides of a double welded butt joint, one spot-examination may represent the work of both welders or welding operators.

(3) Each spot-examination shall be made as soon as practicable after the completion of the increment of weld that is to be examined. The location of the spot shall be chosen by the inspector except that when the inspector has been duly notified in advance and cannot be present or otherwise make the selection, the fabricator may exercise his own judgment in selecting the spots.

(c) Standards for Spot Radiographic Examination Spot-examination by radiography shall be made in accordance with the technique prescribed in Par. UW-51. The minimum length of spot radiograph shall be 6 in. Spot radiographs may be retained or be discarded by the manufacturer after acceptance of the vessel by the inspector. The acceptability of welds examined by spot-radiography shall be judged by the following standards:

(1) Welds in which the radiographs show any type of crack or zone of incomplete penetration shall be unacceptable.

(2) Welds in which the radiographs show slag inclusions or cavities shall be unacceptable if the length of any such imperfection is greater than $^2/_3\ T$ where T is the thickness of the thinner plate welded. If several imperfections within the above limitations exist in line, the welds shall be judged acceptable if the sum of the longest dimensions of all such imperfections is not more than T in a length of 6 T (or proportionately for radiographs shorter than 6 T) and if the longest imperfections considered are separated by at least 3 L of acceptable weld metal, where L is the length of the longest imperfection. The maximum length of acceptable imperfection shall be $^3/_4$ in. Any such imperfections shorter than $^1/_4$ in. shall be acceptable for any plate thickness.

(3) Porosity is not a factor in the acceptability of welds not required to be fully radiographed.

(d) Evaluation and Retests

(1) When a spot, radiographed as required in Pars. (b)(1) or (b)(2), is acceptable in accordance with Pars. (c)(1) and (c)(2), the entire weld length represented by this radiograph is acceptable.

(2) When a spot, radiographed as required in Pars. (b)(1) or (b)(2), has been examined and the radiograph discloses welding which does not comply with the minimum quality requirements of Pars. (c)(1) and (c)(2), two additional spots shall be radiographically examined in the same weld unit at locations away from the original spot. The locations of these additional spots shall be determined by the inspector or fabricator as provided for the original spot examination in Par. (b)(3).

(*a*) If the two additional spots examined show welding which meets the minimum quality requirements of Pars. (c)(1) and (c)(2), the entire weld unit represented by the three radiographs is acceptable. The defective welding disclosed by the first of the three radiographs may be removed and the area repaired by welding, or it may be allowed to remain in the weld joint, at the discretion of the inspector.

(*b*) If either of the two additional spots examined shows welding which does not comply with the minimum quality requirements of Pars. (c)(1) and (c)(2), the entire unit of weld represented shall be rejected. The entire rejected weld shall be removed and the joint shall be rewelded or, at the fabricator's option, the entire unit of weld represented shall be completely radiographed and defective welding only need be corrected.

(*c*) Repair welding shall be performed using a qualified procedure and in a manner acceptable to the inspector.

The rewelded joint, or the weld repaired areas shall be spot radiographically examined at one location in accordance with the foregoing requirements of UW-52.

Delete present Pars. (e), (f), and (g).

PAR. UW-10 Revise to read:

Pressure vessels and pressure-vessel parts shall be stress-relieved as prescribed in Par. UW-40 when stress-relief is required in the applicable part of Subsection C.

PAR. UW-11 Revise to read as follows:

UW-11 Radiographic Examination **(a)** *Full Radiography* Double welded butt joints or their equivalent shall be examined radiographically for their full length in the manner prescribed in Par. UW-51 under any of the following conditions:

(1) The joints are in vessels used to contain lethal substances (See Par. UW-2(a)).

(2) The plate or vessel wall thickness at the welded joint exceeds $1^1/_2$ in., or the lesser thicknesses prescribed in Pars. UCS-57, UHA-33, UCL-35 or UCL-36 for the materials covered therein.

(3) The joints are in unfired steam boilers, the design pressure of which exceeds 50 psi (see Par. U-1(c)(2)).

(4) Butt-welds of inserted type nozzles as shown in Figs. UW-16.1 (Q-1) or (Q-2) join the flange or saddle to the vessel or vessel section that is required to be radiographed or the joint efficiency in (6) is used.

NOTE: Nozzle and manhole attachment welds which are not of the double welded butt-type need not be radiographed.

(5) The joints are in nozzles, sumps, etc. in vessel or vessel section that is required to be radiographed or the joint efficiency in (6) is used, except that circumferential welded butt joints of nozzles and sumps not exceeding 10 in. nominal pipe size or $1^1/_8$ in. wall thickness need not be radiographed.

NOTE: This provision applies to the fabrication and not to the method of attachment to the vessel, which is provided for in (4).

(6) All longitudinal and circumferential joints in a vessel or vessel section where the design of the vessel or vessel section is based on the use of the joint efficiency permitted by Par. UW-12(b); including in the case of a radiographed vessel section the circumferential butt welds joining it to adjacent non-radiographed shell sections or heads, except for the case of a joint between a shell and a head having a design thickness less than that of the radiographed shell section (unless required by Par. UW-11(a)(2)).

(b) *Spot Radiography* All longitudinal and circumferential double-welded butt joints which are not required to be fully radiographed by (a) shall be examined by spot-radiographing in accordance with Par. UW-52, except when any of the following conditions apply.

(1) The design complies with the requirements of Par. UW-12(d).

NOTE: Fillet and/or corner welds permitted by other paragraphs such as for nozzle and manhole attachments, welded stays, flat heads, etc. need not be spot radiographed.

(2) The vessel or vessel part is designed for external pressure only.

(3) A vessel having only circumferential joints between seamless sections (shell or heads) which sections are designed using 80 per cent of the allowable stress value prescribed for the material in Subsection C.

PAR. UW-12 Revise to read as follows:

UW-12 Joint Efficiencies **(a)** Table UW-12 gives the joint efficiencies E to be used in the formulas of this Section of the Code for joints completed by an arc or gas welding process. The joint efficiencies depend on the type of joint and on the degree of examination of the longitudinal and circumferential joints.

(b) The value of E not greater than that given in Column (a) of Table UW-12 shall be used in the design calculations for fully radiographed butt welds (see UW-11(a)).

(c) The value of E not greater than that given in Column (b) of Table UW-12 shall be used in the design calculations for butt-welded joints in vessels or parts of vessels that are spot-radiographically examined in accordance with the requirements of Pars. UW-11(b) and UW-52.

(d) The value of E not greater than that given in Column (c) of Table UW-12 shall be used in the design calculations for joints in vessels that are neither fully radiographed nor spot-radiographically examined provided the entire vessel is designed using values of E from Column (c).

(e) A value of E not greater than 0.80 may be used in the formulas of this Section of the Code for joints completed by forge-welding or by any of the pressure-welding processes given in Par. UW-27(2) provided the welding process used is permitted by the rules in the applicable Parts of Subsection C for the material being welded. The quality of such welds used in vessels or parts of vessels shall be proved as follows: Test specimens shall be representative of the production welding on each vessel. They may be removed from the shell itself or from a prolongation of the shell including the longitudinal joint, or, in the case of vessels not containing a longitudinal joint, from a test plate of the same material and thickness as the vessel and welded in accordance with the same procedure. One reduced-section tension test and two side-bend tests shall be made in accordance with and shall meet the requirements of Pars. Q-6 and Q-8, or QN-6 and QN-8, Section IX.

TABLE UW-12 Revise to read as shown.

PAR. UW-15(b) Revised to read as follows:

(b) *Stress Values for Weld Metal* The allowable stress values for groove and fillet welds and for shear in nozzle necks, in percentages of stress value for the vessel material, are as follows:

	PER CENT
Nozzle-wall shear	70
Groove-weld tension	74
Groove-weld shear	60
Fillet-weld shear	49

TABLE UW-15 Delete.

PAR. UW-18(d) Delete "for stress-relieved welds and 50 per cent for welds hat are not stress-relieved."

PAR. UCS-25 Change reference to "Par. UW-52(b)" to "Table UW-12 Column C."

PAR. UCS-56(g) Delete this paragraph.

PAR. UHA-32(e) Delete this paragraph.

SPECIFICATIONS TO BE ADDED TO TABLE Q-11.1

	Material Spec.	Psi Min Tensile	Type of Material
P-NUMBER 1			
SA-414	Grade A	45,000	Carbon Steel Sheet
	Grade B	50,000	Carbon Steel Sheet
	Grade C	55,000	Carbon Steel Sheet
P-NUMBER 4			
SA-410		60,000	($^3/_4$Cr, $^1/_2$Cu, $^3/_4$Ni, $^1/_4$Al Alloy Pl.)
SA-333	Grade 4	60,000	($^3/_4$Cr, $^1/_2$Cu, $^3/_4$Ni, $^1/_4$Al Alloy Pipe)
SA-350	Grade LF4	60,000	($^3/_4$Cr, $^1/_2$Cu, $^3/_4$Ni, $^1/_4$Al Alloy Forging)

Fig. UA-48 Add the following note:

Fillet radius r to be at least 0.25 g_1, but not less than $^3/_{16}$ in. Raised, tongue-groove, male and female, and ring joint facings shall be in excess of the required minimum flange thickness t.

Par. UA-60(i)(1) Revise to read as follows:

(1) *Welded Joint* The efficiency of a welded joint is expressed as a numerical (decimal) quantity and is used in the design of the joint as a multiplier of the appropriate allowable stress value taken from the applicable table in Subsection C.

SPECIFICATIONS TO BE ADDED TO TABLE QN-11.1

	Material Specification	Product
P-Number 21		
SB-209, SB-210, SB-235	Alloy 996A (99.6 min. Al)	Sheet, Plate, Tube
SB-209	Alloy 990A (99.0 min. Al)	Sheet, Plate, Bar, Rod
SB-209, SB-210, SB-235, SB-241	Alloy M1A (1.2 Mn)	Sheet, Plate, Tube, Bar, Forging
SB-209, SB-210, SB-235	Alloy Clad M1A (1.2 Mn)	Sheet, Plate, Tube
SB-209	Alloy G1A (1.2 Mg)	Sheet, Plate, Tube
P-Number 22		
SB-209	Alloy MG11A (1.2Mn-1.0Mg)	Sheet, Plate, Tube
SB-209	Alloy Clad MG11A (1.2Mn-1.0Mg)	Sheet, Plate
SB-209	Alloy GR20A (2.5Mg-0.25Cr)	Sheet, Plate, Tube
SB-209, SB-210, SB-221, SB-235	Alloy GR40A (3.5Mg-0.25Cr)	Sheet, Plate, Tube
SB-209	Alloy GM 40A (4.0Mg-0.5Mn-0.15Cr)	Sheet, Plate
P-Number 23		
SB-209, SB-210, SB-211, SB-221, SB-235, SB-241, SB-308	Alloy GS11A (1.0Mg-0.6Si-0.25Cr)	Sheet, Plate, Bar, Tube, Forging
SB-209	Alloy Clad GS11A (1.0Mg-0.6Si-0.25Cr)	Sheet, Plate
SB-210, SB-235, SB-241	Alloy GS10A (0.7Mg-0.4Si)	Tube
P-Number 24		
SB-209	Alloy GM41A (4.5Mg-0.8Mn-0.15Cr)	Sheet, Plate
SB-209	Alloy GM51A (5.1Mg-0.8Mn-0.10Cr)	Sheet, Plate

Par. UA-280 Revise as follows:

Example 1 In Line 8, change "not stress-relieved" to "spot-examined."

Under "Unit stresses," first and second expressions, change to read:

Shear in fillet weld = 0.49 × 13,750 = 6,730 psi

Tension in groove weld = 0.74 × 13,750 = 10,180 psi

Under "Strength of connection elements," change A and C to read:

A Fillet weld in shear =
1.57 × 5.5 × 0.375 × 6,730 = 21,800 lb.

C Groove weld in tension =
1.57 × 5.5 × 0.375 × 10,180 = 33,000 lb.

In the 2nd line below C, change "74,150" to "74,800."

In the 3rd line below C, change "51,650" to "53,850."

Example 2 In the fourth sentence, change "not stress-relieved" to "spot-examined."

Under "Unit stresses," 1st and 2nd expressions, change to read:

Shear in fillet weld = 0.49 × 14,350 = 7,030 psi

TABLE UW-12 MAXIMUM ALLOWABLE JOINT EFFICIENCIES FOR ARC AND GAS WELDED JOINTS

No.	Type of Joint Description	Thickness Limitations	Degree of Examination: (a) Fully Radiographed[1]	(b) Spot Examined[2]	(c) Not Spot Examined[3]
(1)	Butt joints as attained by double-welding or by other means which will obtain the same quality of deposited weld metal on the inside and outside weld surfaces to agree with the requirements of Par. UW-35. Welds using metal backing strips which remain in place are excluded.	None	1.00	0.85	0.70
(2)	Single-welded butt joint with backing strip other than those included under (1).	None	0.90	0.75	0.65
(3)	Single-welded butt joint without use of backing strip.	Circumferential joints only, not over $^5/_8$ in. thick and not over 24 in. outside diameter.	..	..	0.60
(4)	Double full-fillet lap joint.	Longitudinal joints not over $^3/_8$ in thick. Circumferential joints[4] not over $^5/_8$ in. thick.	..	..	0.55
(5)	Single full-fillet lap joints with plug welds.	Circumferential joints[4] for attachment of heads not over 24 in. outside diameter to shells not over $^1/_2$ in. thick.	..	..	0.50
(6)	Single full-fillet lap joints without plug welds. (a) (b)	(a) For the attachment of heads convex to pressure to shells not over $^5/_8$ in. required thickness, only with use of fillet weld on inside of shell; (b) or for attachment of heads having pressure on either side, to shells not over 24 in. inside diameter and not over $^1/_4$ in. required thickness with fillet weld on outside of head flange only.	..	..	0.45

[1] See Pars. UW-12(b) and UW-51.
[2] See Pars. UW-12(c) and UW-52.
[3] See Par. UW-12(d).
[4] Joints attaching hemispherical heads to shells are excluded.

TABLE P-6 MAXIMUM ALLOWABLE WORKING STRESSES FOR NONFERROUS MATERIALS IN POUNDS PER SQUARE INCH

Material and Specification Number	Grade, Type or Name	Condition	Notes	Spec. Min. Tens	Subzero to 150	250	300	350	400*	450	500	550	600	700
					For Metal Temperature Not Exceeding Deg F									
COPPER														
Bars														
SB-12	.....	Annealed	..	30000	6700	6300	5000	3800	2500	...	...	...	...	...
Pipe or Tube														
SB-13	.....	Annealed	(2)	30000	6000	5800	5000	3800	2500	...	...	...	...	...
SB-42	.....	Annealed	(2)	30000	6000	5800	5000	3800	2500	...	...	...	...	...
SB-42	.....	Light Drawn	(2)	36000	9000	8300	8000	5000	2500	...	...	...	...	...
SB-42	.....	Hard Drawn	(2)	45000	11300	10500	8000	5000	2500	...	...	...	...	...
SB-75	.....	Annealed	(2)	30000	6000	5800	5000	3800	2500	...	...	...	...	...
SB-75	.....	Light Drawn	..	36000	9000	8300	8000	5000	2500	...	...	...	...	...
SB-75	.....	Hard Drawn	..	45000	11300	10500	8000	5000	2500	...	...	...	...	...
Bar, Rod, or Shapes														
SB-11	.....	Annealed	..	30000	6700	6300	5000	3800	2500	...	...	...	...	...
COPPER ALLOYS														
Castings														
SB-61	.....	....	(1)	34000	6800	6800	6500	6000	5500	5000	4000	3300	...	...
SB-62	.....	....	(1)	30000	6000	5500	5000	4500	3500	...	...	...	...	...
Pipes or Tubes														
SB-43	Red Brass	Annealed	(2)	40000	8000	8000	8000	6000	3000	2000	...	...	...	...
SB-111	Muntz	Annealed	(2)	50000	12500	11200	10500	7500	2000	...	...	...	...	...
SB-111	Admiralty	Annealed	(2)	45000	10000	10000	10000	8000	5000	3000	...	...	...	...
SB-111	Copper-Ni, 70-30	Annealed	(2)	52000	11600	11000	10800	10600	10300	10100	9900	9800	9600	9400
SB-111	Copper-Ni, 80-20	Annealed	(2)	45000	10600	10400	10300	10100	9900	9600	9300	8900	8400	7000
SB-111	Copper-Ni, 90-10	Annealed	(2)	40000	10000	9500	9300	9000	8700	8300	7500	6700	6000	...
Plate or Sheet														
SB-171	Alum. Bronze	Annealed	..	90000	22500	19500	18000	16500	15000	13500	12000	10500	9000	600
SB-171	Naval Brass	Annealed	..	50000	12500	11200	10500	7500	2000	...	...	...	...	...
SB-171	Muntz	Annealed	..	50000	12500	11200	10500	7500	2000	...	...	...	...	...
SB-171	Admiralty	Annealed	..	45000	10000	10000	10000	8000	5000	3000	...	...	...	...
SB-171	Copper-Ni, 70-30	2.5 in. and Under Annealed	..	50000	12200	11600	11300	11000	10800	10600	10400	10200	10000	9700
SB-171	Copper-Ni, 70-30	Over 2.5 in. to 5 in. Annealed	..	45000	10800	10200	9900	9700	9500	9400	9300	9200	9100	8900

Tension in groove weld = $0.74 \times 14{,}350 = 10{,}620$ psi

Under "Strength of connection elements," change A, C, and D to read:

A Inner fillet weld in shear = $1.57 \times 12.75 \times 0.375 \times 7{,}030 = 52{,}800$ lb.

C Groove weld in tension = $1.57 \times 12.75 \times 0.74 \times 10{,}620 = 158{,}000$ lb.

D Outer fillet weld in shear = $1.57 \times 18.75 \times 0.312 \times 7{,}030 = 64{,}500$ lb.

In (1), change 157,200 to 161,100.

In (2), change 200,200 to 210,800.

In (3), change 211,300 to 222,500.

In the last sentence, change 60,600 to 64,500.

Example 3 After the 13th line, add: "The weld sizes used are satisfactory."

Under "Area of reinforcement provided" change A_1 and A_4 to read:

$A_1 = 11.75\ (0.85 \times 0.75 - 0.528) = 1.29$

$A_4 = 2 \times 3.0 \times 0.50 = 3.00$

Change Total from 6.42 to 6.20.

Under "Load to be carried by welds" change W to read:

$W = (6.20 - 1.29)\ 14{,}350 = 70{,}500$ lb

Change A, C, and D to read:

A Inner fillet weld in shear = $1.57 \times 12.75 \times 0.50 \times 7{,}030 = 70{,}300$ lb

C Groove weld in tension = $1.57 \times 12.75 \times 0.74 \times 10{,}620 = 158{,}000$ lb

D Outer fillet weld in shear = $1.57 \times 18.75 \times 0.437 \times 7{,}030 = 90{,}500$ lb

In (1), change 180,400 to 187,100.

In (2), change 216,800 to 228,300.

In (3), change 235,500 to 248,500.

In the last line, change 76,800 to 70,500.

Example 4 Delete "stress-relieved and" in the fifth sentence of the first paragraph.

Example 5 Delete "stress-relieved and" in the sixth sentence of the first paragraph.

Under "Wall thickness required" change the second equation to read:

$$\text{Nozzle } t_{rn} = \frac{500 \times 7.5}{13{,}750 \times 1.00 - 0.6 \times 500} = 0.279 \text{ in.}$$

Before "Area of reinforcement required" add: "The weld sizes used are satisfactory."

Under "Area of reinforcement provided" change second line to read:

$A_2 = 2 \times 2.75\ (0.50 - 0.279) = 1.22$

Change Total from 27.79 to 23.88.

Fig. UA-280.2 Change arrow for B.

Fig. UA-280.3 Change thickness of reinforcing plate from 0.61 in. to 1/2 in. Change arrow for B.

Welding Qualifications, 1956

Table Q-11.1 Add the accompanying specifications.

Table QN-11.1 Add the accompanying specifications. Delete reference to Specifications SB-178, SB-273 and SB-274 for P-Numbers 21, 22 and 23.

Current Engineering Events, News, and Comment

E. S. NEWMAN
News Editor

THE ROUNDUP

Building Fund Grows...

BUT RETURNS ARE SLOW

New milestones in the ASME Member Gifts Campaign to raise funds for the United Engineering Center were passed during the month of August.

By September 1, for the first time, more than half of the Society's 86 Sections had reported returns in their local campaigns. Five new Sections joined the ranks of those who reached more than ten per cent of quota as Erie Section reported 23 per cent, Mid-Hudson 14.8 per cent, Minnesota 14.6 per cent, Baltimore 12.8 per cent, and Utah 11.5 per cent.

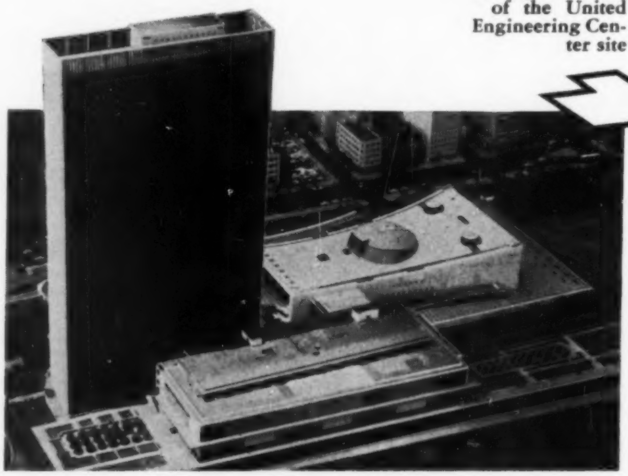
Three Sections followed up their early leads with further substantial progress. Canton-Alliance-Massillon tripled its previous returns to reach a total of 62.7 per cent of quota and West Virginia moved from 37 per cent to 55 per cent during August. In the same period, Nebraska jumped from 21 per cent to nearly 43 per cent.

Other Sections which had achieved more than ten per cent of quota by September 1, including those reporting earlier, were: Atlanta 86.9; Central Iowa 10.9; Kansas City 12.2; Metropolitan 11.2; New Haven 12.2; and Schenectady 68.1.

Counterbalancing these signs of progress from dedicated Section organizations, however, were more somber notes. A large number of Sections hampered by late starts and summer vacations had reported no returns. In other Sections fund-raising efforts were just beginning. With 12 weeks remaining in the campaign, ASME had reached only 8.3 per cent of its over-all quota and, among the Founder Societies, ASME had dropped to last place (see graph).

As Mechanical Engineering goes to press, it was learned that ASME had reached 10.5 per cent of its quota with 10 weeks remaining.

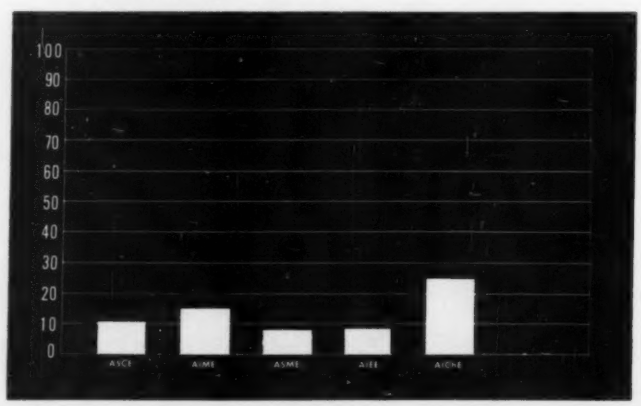
This photograph, which appeared in hundreds of newspapers recently as world interest focused on New York's United Nations Headquarters, clearly shows the strategic location of the United Engineering Center site



Despite these indications of a late start, however, the committee expressed confidence in Section leaders and faith in the willingness and ability of the membership-at-large to make the long-range campaign a success.

Meanwhile, other fund-raising efforts continued as total subscriptions reached nearly $4 million, including industry gifts. It has been announced that an additional $2 million is available from present resources. This leaves slightly over $4 million to be raised toward the total goal of $10 million.

Results of Member Gifts Campaign conducted by five Founder Societies, in terms of per cent of quota reached by Sept. 1, 1958



Engineering Comes of Age

BY W. F. RYAN, *CHAIRMAN*, ASME MEMBER GIFTS CAMPAIGN COMMITTEE

ENGINEERING, they say, is a young profession, and in contrast with the countless centuries during which the practitioners of law and medicine, for example, have labored for recognition and prestige, perhaps it is.

But engineering is coming of age.

Only 50 years ago, around the time the present Engineering Societies Building was erected as a "home for the profession," it would have been almost unthinkable that engineers themselves would help to finance construction. The profession was weak, with little sense of pride, and only a feeble notion of unity.

The planners of the present structure, instead, had to lean on an outside source of funds, a "patron" whose interest in engineering prompted him to underwrite the total cost of today's building.

Today the profession has grown up. Engineers stand erect and independent in their own right. From their new height they can see and appreciate the value of a suitable headquarters for co-ordinated engineering effort. And, with the new United Engineering Center in the offing, individual engineers are assuming their fair share of the financial burden. Every member of ASME as well as of other societies will have an opportunity to participate.

One of the attributes of a profession is the obligation to help those who follow. It is hard to conceive of a more effective way to insure the future strength and status of the profession. In a single stroke the new Center will enormously augment the effectiveness of the societies it will house. At the same time, in its strategic setting opposite the United Nations, the Center will tower as a source of pride to those who built it.

Bordering on a broad, parklike expanse near the river front it will stand—a showplace visible for miles. At this crossroads of world sight-seeing it cannot help but impress visitors—thousands of youngsters, tourists, and world leaders daily—with the creativity and strength of purpose of America's engineers.

In the months ahead, by investing in this opportunity which has not come before and probably will not come again in our lifetime, ASME members will justify the faith of their predecessors, the confidence of their colleagues, and of the hope of the nation for years to come.

Alaska IS FIRSTEST WITH THE MOSTEST

Alaska, newest of the United States, has spurted ahead of its older sisters in the United Engineering Center Member Gifts Campaign. As of press time, 66⅔ per cent of ASME's northernmost members have responded to a request for funds. The fact that ASME members are scarce in Alaska, and 66⅔ per cent represents just two men of the three members carried on current records, does not seem to detract from this demonstration of faith in the engineering profession. For coupled with it are gifts of members in other remote spots such as Venezuela, Germany, Colombia, Spain, and England.

Despite the miles that separate them from the United Engineering Center in New York, members around the world are recognizing its value to engineers everywhere.

Per Cent of Quotas

REACHED BY ASME REGIONS, SEPT. 1, 1958

Region I (New England area)	3.6%
Region II (New York area)	10.8
Region III (Mid-Atlantic area)	8.0
Region IV (Southeast area)	9.1
Region V (Mid-Great Lakes area)	6.1
Region VI (Midwest area)	2.8
Region VII (Southwest area)	0.7
Region VIII (Far West area)	2.7
Per Cent of Total	8.3%

Founder Societies in Cincinnati have joined forces to canvass members for United Engineering Center Fund. Left to right are: Kenneth H. Pettengill, AIChE; Cornelius Wandmacher, ASCE; Ernest S. Fields, Chairman, Sponsoring Committee; Harry S. Progler, AIEE; Lester L. Bosch, ASME.

TRITON, America's Newest Underseas Watchdog, Can Read and Write

Admiral Rickover calls launching a significant event in nuclear propulsion-plant development and a symbol of future submersible capital ships

More than 30,000 turned out to witness the launching of the Nation's eighth nuclear-powered submarine, *Triton*, Aug. 19, 1958, at the Groton (Conn.) shipyard of General Dynamics Corporation's Electric Boat Division on the Thames River.

Triton Firsts

The *Triton* is the largest undersea craft ever built and the first ship in history to be powered by twin nuclear power plants. Displacing 5900 tons, she is 447 ft long with a beam of 37 ft. Designed for radar picket duty, *Triton* is more than 66 ft longer than any other U. S. submarine, dwarfing even her atomic predecessors, including the *Nautilus* and *Skate* of recent North Pole exploits fame. *Triton* is the first submarine to be designed for three deck levels within the hull. Another first on the *Triton* is a 40-line switchboard which monitors a dial telephone system throughout the ship. The nuclear-powered *Triton* is fitted with high-power radar and sonar gear and will travel with high-speed carrier task forces. Her job will be to run ahead of the main fleet and serve as an early warning station, reporting back on approaching enemy planes, submarines, and surface vessels.

Admiral H. G. Rickover, who was hailed as the father of atomic submarines, summed up in a telegram read by Frank Pace, Jr., president of General Dynamics, at the launching ceremonies, as follows: ". . .I consider this to be a significant event in Naval history. The *Triton* will pioneer the submarine technology necessary for capital ships of the future to operate submerged. A few years ago many said it was neither practical nor desirable to build such a large submarine. Today, large missile-firing submarines are under construction in this very yard—*Triton* had led the way...The significance of today's launching goes beyond the addition of this important ship to the fleet.

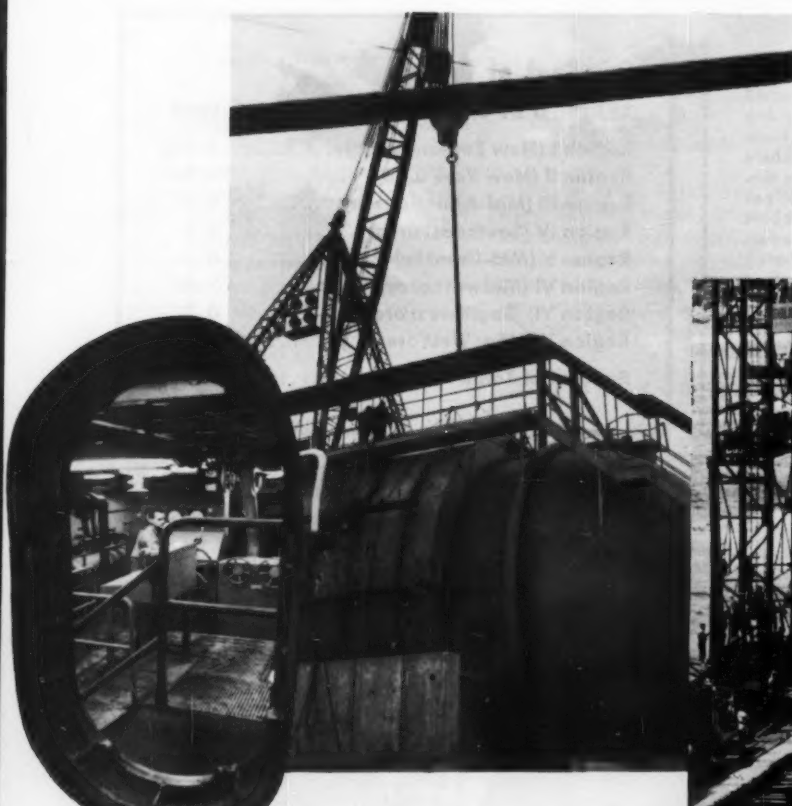
"It marks the development of an advanced type nuclear propulsion plant and symbolizes the submersible capital ship of the future. . ."

Admiral Jerauld Wright, Commander-in-Chief of the U. S. Atlantic Fleet and Supreme Allied Commander Atlantic since April, 1954, principal speaker, called the launching a "milestone" in technical accomplishments and a "marvel" of skilled engineering design.

"More than that," he said, "she is a step forward in the solution of the most pressing problem of the United States and her friends in the free world.

"The foremost task which confronts our nation today is the prevention of war. The only real preventive of war," he said, "is preparedness. Preparedness means an ability to convince any nation or combination of nations that if they attack they will fail."

Thousands watch world's largest and most powerful submarine, atomic-powered *Triton*, slide into the Thames River at Groton, Conn., Shipyard of General Dynamics Corporation's Electric Boat Division, Aug. 19, 1958. Twin-reactored *Triton*, radar picket sub, is 447 ft long with a 5900-ton displacement, is fifth nuclear sub launched by General Dynamics.



Controls for land-based prototype power plant for *Triton* are shown inside submarine hull section located at West Milton, N. Y., test site of the GE Knolls Atomic Power Laboratory. KAPL also is designing and developing the propulsion system to be installed aboard the *Triton*. Huge crane is used to complete land-based submarine hull section which houses prototype propulsion system.

"*Triton* is the eighth nuclear-powered submarine to be launched by the United States," said Admiral Wright, "the eighth successful 'first' in this field; for no other nation, as yet, has constructed a successful atomic propelled ship."

In describing how the Navy plans to use the *USS Triton*, he said the primary armament of the sub will not be the "torpedo of her sisters, but rather the instrumnets for handling radio, radar, and television. . .Although nuclear propelled, will not be armed with nuclear weapons. She will use her nuclear power plant to strengthen and improve our existing atomic delivery capability. She will accompany the strike fleet, always well in advance. Her high underwater speed and long endurance given her by her twin nuclear reactors, will enable her to remain submerged undetected, and to penetrate deep into the sea areas adjacent to the enemy coasts. Her ultramodern radar; a virtual 'electronic periscope,' with a range 100 times that of an optical periscope, will send down information to her combat information center for evaluation and transmission. She will thus be a nuclear-propelled, invisible, electronic brain, hundreds of miles in advance of our atomic strike fleet, always ready to guide and direct its atomic delivery forces and to defend their source."

Admiral Wright saluted the *Triton* as the "result of much talent and endeavor on the part of many dedicated men," and cited Rear Admiral Hyman G. Rickover, ASME George Westinghouse Gold Medalist of 1955, Chief of the Nuclear Reactors Branch, Atomic Energy Commission, and Assistant Chief of the Navy's Bureau of Ships; and Rear Admiral Albert G. Mumma, Chief of the Navy's Bureau of Ships.

Two civilians saluted included Carleton Shugg, general manager of the Electric Boat Division of General Dynamics, and Frederick E. Crever, general manager of General Electric's Knolls Atomic Power Laboratories.

Speaking at the ceremonies Mr. Crever said that the twin reactor system used to propel the *Triton* is evidence that it is possible to couple and join nuclear reactors to get more reliability and greater power. He also pointed out that nuclear propulsion units are a little closer to mass production because of knowledge gained in building fuel elements and reactors.

Triton Propulsion System

The propulsion system for the *Triton* was designed and developed by KAPL at Schenectady and is the first twin-reactor propulsion system ever built for ships. Both reactors will be cooled and moderated by pressurized water.

New and important advance in reactor design for the *Triton* system include:

1 Higher shaft hp developed by each reactor than any other submarine power plant.

2 Lower weight per shaft hp than any other nuclear submarine propulsion unit.

3 Most compact core of water-cooled reactors used in any submarine launched. The *Seawolf* system, also designed by KAPL, was smaller due to the use of sodium as a coolant.

4 Use of new twisted-ribbon-type fuel elements offering the possibility of increasing heat-transfer efficiency over plate-type elements with a decreased cost of manufacture.

5 Use of revolutionary unit-cell construction. A unique arrangement of separate and distinct unit cells make up the reactor core.

6 In-hull refueling due to unit-cell construction.

7 Refueling access through small hatch in hull.

8 Saving of about four weeks in refueling time over earlier nuclear submarines, thus providing the equivalent of one additional submarine in service per year for every 25 submarines with *Triton*-type reactors placed in service.

9 Refueling at sea anchorage made possible by in-hull refueling system. Other nuclear submarines must be refueled at dockside to take advantage of heavier crane equipment.

10 Mass-production methods readily applied to fuel elements and unit cells used in *Triton*.

11 Choice of using one or two reactors for operation of the ship.

Triton, the fifth nuclear submarine launched by Electric Boat Division of General Dynamics, is the 333rd submarine launched by EB, which inaugurated the undersea era in 1897 with the *Holland*.

Science and Technology as Instruments for the Peaceful Development of Israel and the Middle East—Topic of Conference

More than 500 leading scientists, engineers, and technicians from all parts of the United States will meet in New York City for a weekend of intensive discussions designed to strengthen the peaceful development of the Middle East.

The American Technion Society is sponsoring the second triennial Conference on Science and Technology for the Peaceful Development of Israel and the Middle East to be held on Oct. 11 and 12, 1958, at the Hilton-Statler Hotel, New York City.

The conference will be devoted to four principal areas of study. These are: The development of energy sources; the conservation of soil and water; planning for industrial development; and planning for social development.

Among the outstanding scientists and engineers, specialists in their respective fields, who will address the conference sessions will be: Philip Sporn, Hon. Mem. ASME, president of the American Electric Power Service Corporation, and recognized specialist in the peaceful uses of atomic energy; Joseph Weil, dean of the College of Engineering, University of Florida; W. C. Lowermilk, world-renowned authority on soil conservation and problems of erosion; Ernest Weissmann of Housing, Building, and Planning Division of the United Nations; V. E. Bolis of the University of Milan, attached to the Middle East Division of UN; and Joseph Barnea of the UN Water Resources and Power Section.

The American Society for Technion-Israel Institute of Technology, known also as the American Technion Society, is a nationwide organization composed in the main of scientists, engineers, technicians, and industrialists.

The principal objective of the Society is to foster and advance the only engineering university in Israel—the Technion-Israel Institute of Technology, located in Haifa, and seeks to widen the "technological approach" in Israel's efforts to achieve economic independence.

The Technion is nonsectarian and has a number of Arab students and faculty members. The only qualifications that are considered for admission—both for students and faculty—are those of ability and academic background.

The American Technion Society believes that the dissemination of scientific knowledge among all the peoples of the Middle East, and the free interchange of technological know-how by Jew and Arab, will strengthen chances for peace and progress in that crucial part of the world.

The real value of this conference lies in the fact that it offers an opportunity for science and technology to be used as instruments for peace and tranquility in the Middle East.

Section M—Engineering Program for AAAS 125th Annual Meeting, Washington, D. C., to Study World-Wide Measurement Systems

Two-day meeting to hear discussions by authorities on unit systems and practices seeking greater interchange of knowledge to aid commerce and industry

During the 125th annual meeting of the American Association for the Advancement of Science to be held in Washington, D. C., Dec. 26–31, 1958, Section M—Engineering will present a program based on the theme, "The National and International Aspects of Systems of Units in Co-ordinated Disciplines of Science and Technology," at the Hotel Statler, December 29–30.

Chairman C. F. Kayan, Mem. ASME, recently announced details of the Section M program. The primary purpose of the program will be to focus attention on the growing international problems created by widespread use of different systems of units, and their relation to the U. S. system and operations. The program is being planned to clarify the existing confusion of identification and to inform engineers and scientists of the conversion difficulties and problems in international communications and commerce.

Subjects to be covered include: (*a*) English versus Metric Units and (*b*) Absolute versus Gravitational (technical systems); (*c*) review of the MKSA System (meter, kilogram-mass, second, and ampere) and the Absolute System.

Authorities will present viewpoints from home and abroad on the unit systems and practices, including problems of standardization and the decimalization within the English system. Consideration of unification and simplification also will include common usage, civilian versus military aspects, and industrial production versus analytical design.

On Monday, December 29, American methods will be discussed by representatives of the National Bureau of Standards in a session on "The Problem: National and International Status of Systems." Leaders from organizations who represent both the United States and major European countries will analyze their present methods during this session.

Session two, on Monday and continuing on Tuesday, will be devoted to comparison of different systems in various major industrial fields. Subsections will include technology, industry and defense, and commerce and trade. This portion of the program will present case histories of utilization of systems of measurement, including methods of conversion used in industry to meet industry's requirements, both national and international.

The third session on possible methods for unification and simplification will consider papers from Sweden, Germany, and several other foreign countries indicating methods now in use and which might be applicable in simplifying the complex systems of measurement.

The detailed program may be obtained by writing to: Secretary, Section M—Engineering, c/o Engineers Joint Council, 29 West 39th St., N. Y. 18, N. Y.

MEETINGS OF OTHER SOCIETIES

Oct. 15–25

International Textile Machinery and Accessories Exhibition, Manchester, England

Oct. 16–17

Illinois Institute of Technology and Armour Research Foundation, annual conference on industrial hydraulics, Hotel Sherman, Chicago, Ill.

Oct. 20–21

Instrument Society of America, national rubber and plastics instrumentation symposium, Akron, Ohio

Oct. 21

American Society of Safety Engineers, annual meeting, Conrad Hilton Hotel, Chicago, Ill.

Oct. 21–23

Engineering Industries Association, regional display, London, England

Oct. 22–Nov. 1

International Motor Show, London, England

Oct. 23–25

National Society of Professional Engineers, fall meeting, St. Francis Hotel, San Francisco, Calif.

Oct. 23–25

Rocket Technology and Astronautics, international meeting, Essen, Germany

Oct. 26–31

American Institute of Electrical Engineers, fall general meeting, Penn-Sheraton Hotel, Pittsburgh, Pa.

Oct. 27–31

American Society for Metals, national metal congress and exposition, Statler-Hilton Hotel, Cleveland, Ohio

Oct. 30–31

Society for the Advancement of Management, fall conference, Statler-Hilton Hotel, New York, N. Y.

Nov. 10–12

American Petroleum Institute, annual meeting, Conrad Hilton Hotel, Chicago, Ill.

Nov. 10–13

Flight Safety Foundation, annual international air safety seminar, Atlantic City, N. J.

Nov. 12–14

Society for Experimental Stress Analysis, annual meeting, Sheraton-Ten-Eyck Hotel, Albany, N. Y.

Nov. 12–15

Society of Naval Architects and Marine Engineers, annual meeting, Waldorf-Astoria Hotel, New York, N. Y.

Nov. 16–21

American Documentation Institute, National Academy of Sciences-National Research Council, and the National Science Foundation, International conference on scientific information, Washington, D. C.

(*For ASME Coming Events, see page 141.*)

I. MECH. E MEETINGS

Oct. 28

Symposium on Aluminum Pressure Vessels, I. Mech. E., London, England

▶*Note:* The foregoing calendar of The Institution of Mechanical Engineers (Great Britain) meetings is published as a service to members of ASME. Further information relating to complete programs and available papers may be obtained from The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminister, London, S. W. 1, England. Preliminary programs also are published in *The Chartered Mechanical Engineer* (I.Mech.E.) which is on file in the Engineering Societies Library, 29 West 39th Street, New York 18, N. Y., and other libraries throughout the United States and Canada.

Notes on Society Activities and Events

E. S. NEWMAN
News Editor

THE ASME NEWS

"New Frontiers in Engineering—Key to Mankind's Progress"—Theme of 1958 ASME Annual Meeting

Statler-Hilton and Sheraton-McAlpin Hotels, New York City, to be focal points for biggest technical meeting of the year

Feature Events of the 1958 Annual Meeting

MONDAY, DECEMBER 1

12:15 p.m.
President's Luncheon
Presentation of
Worcester Reed Warner Medal
Melville Prize Medal
Blackall Machine Tool Award
Speaker: *J. N. Landis*, ASME President

4:45 p.m.
Business Meeting

8:00 p.m.
Social Get-Together

TUESDAY, DECEMBER 2

9:15 a.m.
New York International Airport Tour

12:15 p.m.
Fuels Luncheon
Presider: *J. G. McCabe*, Combustion Publishing Co., N. Y.
Presentation of
ASME George Westinghouse Gold Medal
Prime Mover Committee Award
Speaker: *Philip Sporn*, president, American Electric Power Co., New York, N. Y.

12:15 p.m.
Metals Engineering Luncheon

12:15 p.m.
Machine Design Luncheon and Thurston Lecture
Lecturer: *Rudolph A. Beyer*, professor of mechanical engineering at the Technical University in Munich. As a specialist in kinematics he has written several important books on the subject; entries in various encyclopedias, more than 80 articles, and numerous other publications. Consultant in applied mechanics.

1:00 p.m.
Public Service Company of New Jersey Tour

4:00 p.m.
Tea Dance

6:00 p.m.
Applied Mechanics Dinner
Toastmaster: *W. Ramberg*, chairman, ASME Applied Mechanics Division; Chief, Mechanics Division, Washington, D. C.
Presentation of three Timoshenko Medals
Responses by Recipients of Timoshenko Medal

7:00 p.m.
Petroleum Dinner
Presider: *H. H. Meredith, Jr.*, chairman, ASME Petroleum Division; Division Engineer, Humble Oil & Refining Co., Tyler, Texas.
Speaker: *E. V. Murphree*, president, Esso Research & Engineering Co., Linden, N. J.; president and chairman, Fifth World Petroleum Congress, Inc.; chairman, Permanent Council of the World Petroleum Congress.

WEDNESDAY, DECEMBER 3

12:15 p.m.
Heat Transfer Luncheon
Speaker: *H. A. Johnson*, Univ. of California
Subject: Heat-Transfer Research in the Far East and Europe

12:15 p.m.
Management Luncheon and Towne Lecture
Lecturer: *Walter E. Boveri*, Brown Boveri Co., Ltd., Baden, Switzerland

2:30 p.m.
Tour of the Engineering Societies Building and New United Engineering site

6:30 p.m.
Hydraulic Old Timer's Stag Dinner
Presider: *G. Dugan Johnson*, chief hydraulic engineer, S. Morgan Smith Co., York, Pa.
Speaker: *Robert A. Riester*, assistant manager, machinery department, Carrier Corp., Syracuse, N. Y.

THURSDAY, DECEMBER 4

9:30 a.m.
Visit aboard the *SS Independence* of American Export Line

12:15 p.m.
Members and Students Luncheon and Roy V. Wright Lecture
Presentation of
Richards Memorial Award
Pi Tau Sigma Gold Medal Award
Old Guard Prize
Charles T. Main Award
Undergraduate Student Award
Lecturer: *J. W. Barker*, past-president, ASME; president and chairman of the board, Research Corp., New York, N. Y.
Subject: Why Should Engineers Vote?

2:30 p.m.
Jacob Ruppert Brewing Co. Tour

6:00 p.m.
Social Hour

7:00 p.m.
Banquet
Presentation of
ASME Medal
Honorary Membership (4)
Guggenheim Medal
Speaker: *J. H. Furbay*, director, World Wide Educational Program, Trans World Airlines, Inc., New York, N. Y.
Subject: Global Human Relations

FRIDAY, DECEMBER 5

12:15 p.m.
Wood Industries Luncheon
Speaker: *E. C. Warrick*, Rockwell Mfg. Co., Pittsburgh, Pa.
Subject: Reaction to American Woodworking Machinery at Brussell's World Fair

12:15 p.m.
Textile Engineering Luncheon

TECHNICAL PROGRAM

APPLIED MECHANICS SESSIONS

Ia MONDAY, DECEMBER 1 9:30 a.m.

The Nonlinear Bending of Thin Rods, by *T. P. Mitchell*, Cornell Univ. (Paper No. 58—A-50)

Buckling of Struts of Variable Bending Rigidity,[2] by *M. M. Abbassi*, University of Alexandria, Alexandria, Egypt (Paper No. 58—A-39)

Direct Determination of Stresses in Plane Elasticity Problems Based on the Properties of Isostatics, by *P. S. Theocaris*, Illinois Inst. of Tech. (Paper No. 58—A-43)

The Wedge Under a Concentrated Couple: A Paradox in Two-Dimensional Theory of Elasticity,[2] by *E. Sternberg*, Brown Univ., and *W. T. Koiter*, Technische Hogeschool, Delft, Holland (Paper No. 58—A-15)

Stresses in a Stretched Slab Having a Spherical Cavity,[2] by *Chih-Bing Ling*, Aeronautical Research Lab., Taichung, Taiwan (Formosa) (Paper No. 58—A-45)

The End Problem of Cylinders, by *Gabriel Horvay* and *J. A. Mirabal*, Gen. Elec. Co. (Paper No. 58—A-24)

The Stresses in a Thick Cylinder Having A Square Hole Under Concentrated Loading,[2] by *M. Seika*, Tohoku Univ., Sendai, Japan (Paper No. 58—A-22)

A Theorem of Maximum Strain Energy,[2] by *E. H. Brown*, Imperial College of Sci. & Tech., London, England (Paper No. 58—A-40)

Ib MONDAY, DECEMBER 1 9:30 a.m.

Jointly with Plastic Flow of Metals, Metals Engineering, Lubrication, and Production Engineering

See Plastic Flow of Metals

IIa MONDAY, DECEMBER 1 2:30 p.m.

Axially Symmetric Buckling of Shallow Spherical Shells Under External Pressure, by *E. L. Reiss*, NYU (Paper No. 58—A-14)

On Influence Coefficients and Nonlinearity for Thin Shells of Revolution,[2] by *E. Reissner*, M.I.T. (Paper No. 58—A-33)

The Strain Energy Expression for Thin Elastic Shells,[2] by *J. H. Haywood* and *L. B. Wilson*, Naval Construction Research Establishment, Dunfermline, Fife, Scotland (Paper No. 58—A-25)

A Fresh Test of the Epstein Equations for Cylinders,[2] by *E. H. Kennard*, David Taylor Model Basin (Paper No. 58—A-18)

Post-Buckling Behavior of Rectangular Plates With Small Initial Curvature Loaded in Edge Compression,[2] by *N. Yamaki*, Tohoku Univ., Sendai, Japan (Paper No. 58—A-59)

Stresses and Deflections in an Elastically Restrained Circular Plate Under Uniform Normal Loading Over a Segment,[2] by *W. A. Bassali* and *M. Nassif*, Univ. of Alexandria, Alexandria, Egypt (Paper No. 58—A-27)

Transverse Flexure of a Thin Plate Containing Two Circular Holes,[2] by *O. Tamate*, Tohoku Univ., Sendai, Japan (Paper No. 58—A-35)

Analysis of a Compression Test of a Model of a Granular Medium, by *C. W. Thurston* and *H. Deresiewicz*, Columbia Univ. (Paper No. 58—A-48)

A Differential Stress-Strain Relation for the Hexagonal Close-Packed Array of Elastic Spheres, by *Jacques Duffy*, Brown Univ. (Paper No. 58—A-53)

[2] Not presented orally.

IIb MONDAY, DECEMBER 1 2:30 p.m.

Jointly with Hydraulic

See Hydraulic IIa

IIIa TUESDAY, DECEMBER 2 9:30 a.m.

Colloquium: Mechanical Impedance Methods for Vibration Problems—Part 1

Introduction to Mechanical Impedance Methods for Vibration Problems,[1] by *Robert Plunkett*, Gen. Elec. Co.

Impedance and Mobility Analysis of Lumped Parameter Systems,[1] by *S. H. Crandall*, M.I.T.

Impedance Analysis of Distributed Mechanical Systems,[1] by *D. V. Wright*, Westinghouse Research Labs.

Four-Pole Parameters in Vibration Analysis,[1] by *C. T. Molloy*, Lockheed Aircraft Corp.

Methods for the Measurement of Mechanical Impedance,[1] by *G. M. Coleman*, U. S. Naval Electronics Lab.

IIIb TUESDAY, DECEMBER 2 9:30 a.m.

Jointly with Production Engineering and Machine Design

See Production Engineering II

IV TUESDAY, DECEMBER 2 2:30 p.m.

Colloquium: Mechanical Impedance Methods for Vibration Problems—Part 2

Dynamic Behavior of Foundation-Like Structures,[1] by *V. H. Neubert* and *W. H. Ezell*, Gen. Dynamics Corp.

Measurements of Foundation Impedance,[1] by *D. F. Muster*, Gen. Elec. Co.

The Significance of Impedance in Shock and Vibration,[1] by *R. E. Blake*, Lockheed Missile Systems Div. and *R. O. Belsheim*, U. S. Naval Research Lab.

Vibration Isolation of Nonrigid Bodies,[1] by *R. D. Cavanaugh* and *J. E. Ruzicka*, Barry Controls, Inc.

Impedance of Some Disordered Systems,[1] by *J. L. Bogdanoff* and *P. F. Chenea*, Purdue Univ.

Impedance Concepts Applied to Systems Excited by Random Oscillatory Forces,[1] by *M. Strasberg*, David Taylor Model Basin

V WEDNESDAY, DECEMBER 3 9:30 a.m.

An Experimental Surface-Wave Method for Recording Force-Time Curves in Elastic Impacts,[2] by *J. N. Goodier*, Stanford Univ., *W. E. Jahsman*, Lockheed Missile Systems Div., and *E. A. Ripperger*, Univ. of Texas (Paper No. 58—A-51)

The Effect of Product of Inertia Coupling on the Natural Frequencies of a Rigid Body on Resilient Supports,[2] by *C. E. Crede*, Calif. Inst. of Tech. (Paper No. 58—A-9)

Natural Forcing Functions in Nonlinear Systems, by *T. J. Harvey*, Lockheed Missile Systems Div. (Paper No. 58—A-6)

Forced Torsional Vibration of Systems With Distributed Mass and Internal and External Damping,[2] by *K. E. Bisshopp*, Rensselaer Poly. Inst. (Paper No. 58—A-8)

Normal Vibrations of a Uniform Plate Carrying Any Number of Finite Masses, by *W. F. Stokey* and *C. F. Zorowski*, Carnegie Inst. of Tech (Paper No. 58—A-28)

Transients in Simple Undamped Oscillators Under Inertial Disturbances,[2] by *A. Dornig*, Poly. Inst. of Milan, Milan, Italy (Paper No. 58—A-58)

On the Natural Modes and Their Stability in Nonlinear Two-Degree-of-Freedom Systems, by *R. M. Rosenberg* and *C. P. Atkinson*, Univ. of Calif. (Paper No. 58—A-57)

[1] Paper not available—see box on page 117.

VI WEDNESDAY, DECEMBER 3 2:30 p.m.

On Journal Bearings of Finite Length With Variable Viscosity, by *L. N. Tao*, Illinois Inst. of Tech. (Paper No. 58—A-75)

The Effect of Turbulence on Slider-Bearing Lubrication, by *Ye Tsang Chou*, U. S. Steel Corp. and *E. Saibel*, Rensselaer Poly. Inst. (Paper No. 58—A-30)

Transient Film Condensation, by *E. M. Sparrow* and *R. Siegel*, NACA, Lewis Flight Propulsion Lab. (Paper No. 58—A-13)

Analysis of the Thermoelectric Effects by Methods of Irreversible Thermodynamics, by *G. N. Hatsopoulos* and *J. H. Keenan*, M.I.T. (Paper No. 58—A-1)

The Effect of a Nonisothermal Free Stream on Boundary-Layer Heat Transfer,[2] by *E. M. Sparrow* and *J. L. Gregg*, NACA, Lewis Flight Propulsion Lab. (Paper No. 58—A-42)

VII THURSDAY, DECEMBER 4 9:30 a.m.

Stress Distribution and Plastic Deformation in Rotating Cylinders of Strain-Hardening Material, by *E. A. Davis* and *F. M. Connelly*, Westinghouse Research Labs. (Paper No. 58—A-10)

Determination of the Creep Deflection of a Rivet in Double Shear, by *J. Marin*, Pennsylvania State Univ. (Paper No. 58—A-47)

Retarded Flow of Bingham Materials, by *A. Slibar*, Technische Hochschule, Stuttgart, West Germany, and *P. R. Paslay*, Gen. Elec. Co. (Paper No. 58—A-34)

Plastic Stress-Strain Relationships—Some Experiments on the Effect of Loading Path and Loading History,[2] by *S. S. Gill* and *J. Parker*, Univ. of Manchester, Manchester, England (Paper No. 58—A-11)

A Mathematical Derivation of the Stress-Strain Diagram and the Hysteresis Loop, by *I. R. Whiteman*, Gen. Analysis Corp. (Paper No. 58—A-68)

On the Carrying Capacity of Plates of Arbitrary Shape and Variable Fixity Under a Constant Load,[2] by *M. Zaid*, Republic Aviation Corp. (Paper No. 58—A-20)

Limit Analysis of Symmetrically Loaded Thin Shells of Revolution,[2] by *D. C. Drucker* and *R. T. Shield*, Brown Univ. (Paper No. 58—A-26)

VIII THURSDAY, DECEMBER 4 2:30 p.m.

Transient and Residual Stresses in Heat-Treated Cylinders, by *J. H. Weiner*, Columbia Univ., and *J. V. Huddleston*, Yale Univ. (Paper No. 58—A-21)

Elastic, Plastic Stresses in Free Plate With Periodically Varying Surface Temperature,[2] by *H. Yuksel*, Brown Univ. (Paper No. 58—A-16)

Relief of Thermal Stresses Through Creep, by *H. Poritsky* and *F. A. Fend*, Gen. Elec. Co. (Paper No. 58—A-41)

Ductile Fracture Instability in Shear, by *F. A. McClintock*, M.I.T. (Paper No. 58—A-12)

A Definition of Stable Inelastic Material,[2] by *D. C. Drucker*, Brown Univ. (Paper No. 58—A-31)

A Reassessment of Deformation Theories of Plasticity, by *B. Budiansky*, Harvard Univ. (Paper No. 58—A-54)

Collapse Loads of Rings and Flanges Under Uniform Twisting Moment and Radial Forces, by *Burton Paul*, Brown Univ. (Paper No. 58—A-55)

IXa FRIDAY, DECEMBER 5 9:30 a.m.

Analytical Design of Disk Cams and Three-Dimensional Cams by Independent Position Equations, by *F. H. Raven*, Univ. of Notre Dame (Paper No. 58—A-17)

The Synthesis of Four-Bar Mechanisms for Prescribed Extreme Values of the Angular Velocity of the Driven Link,[2] by *J. Hirschhorn*, New South Wales Univ. of Tech., Sydney, Australia (Paper No. 58—A-2)

The Effect of a Tangential Contact Force Upon the Rolling Motion of an Elastic Sphere on a Plane, by *K. L. Johnson*, Univ. of Cambridge, Cambridge, England. (To be presented by *J. N. Goodier*, Stanford Univ.) (Paper No. 58—A-7)

The Effect of Tangential Forces and Spin Upon the Rolling Motion of an Elastic Sphere on a

Registration Schedule

Sunday, November 30, 2:00 p.m. to 5:00 p.m.
Monday, December 1, 8:00 a.m. to 5:00 p.m.
Tuesday, December 2, 8:00 a.m. to 8:00 p.m.
Wednesday, December 3, 8:00 a.m. to 8:00 p.m.
Thursday, December 4, 8:00 a.m. to 3:00 p.m.
Friday, December 5, 8:00 a.m. to 3:00 p.m.

Plane, by *K. L. Johnson*, Univ. of Cambridge, Cambridge, England. (To be presented by *J. N. Goodier*, Stanford Univ.) (Paper No. 58—A-5)

Frequencies of a Flexible Circular Plate Attached to the Surface of a Light Elastic Half-Space,[2] by *G. N. Bycroft*, Dominion Physical Lab., Lower Hutt, New Zealand (Paper No. 58—A-37)

Root-Locus Analysis of Structural Coupling in Control Systems, by *R. H. Cannon, Jr.*, M.I.T. (Paper No. 58—A-65)

Analysis of Complex Kinematic Chains With Influence Coefficients,[2] by *Joseph Modrey*, Union College (Paper No. 58—A-74)

IXb FRIDAY, DECEMBER 5 9:30 a.m.

Jointly with Power

See Power X

X FRIDAY, DECEMBER 5 2:30 p.m.

Unsteady Laminar Boundary Layers in an Incompressible Stagnation Flow, by *Kwang-tzu Yang*, Univ. of Notre Dame (Paper No. 58—A-3)

Unsteady Laminar Boundary Layers Over an Arbitrary Cylinder With Heat Transfer in an Incompressible Flow, by *Kwang-tzu Yang*, Univ. of Notre Dame (Paper No. 58—A-49)

Laminar Flow in a Uniformly Porous Channel, by *F. M. White, Jr.*, and *B. F. Barfield*, Georgia Inst. of Tech.; and *M. J. Goglia*, Univ. of Notre Dame (Paper No. 58—A-19)

Theory of Flight of the Sounding Rocket,[2] by *V. C. Liu*, Univ. of Michigan (Paper No. 58—A-32)

An Experiment on Compressible Flow Perturbations,[2] by *R. E. Meyer*, Brown Univ., and *T. A. d'Ews Thomson*, Univ. of Sydney, Sydney, Australia (Paper No. 58—A-52)

AVIATION SESSIONS

I TUESDAY, DECEMBER 2 9:30 a.m.

Jointly with Heat Transfer

See Heat Transfer III

II TUESDAY, DECEMBER 2 2:30 p.m.

Jointly with Heat Transfer

See Heat Transfer IV

IIIa WEDNESDAY, DECEMBER 3 9:30 a.m.

Paper on the Caravelle,[1] by *A. Vautier*, Sud-Aviation, Paris, France (To be presented by *Jacques Cornillon*, ENSA Engr., Point Pleasant, Pa.)

Mechanical Design Philosophy Applied to Convair Jet-Transport-Aircraft Systems,[1] by *J. T. Ready, Jr.*, Convair

Paper on the Boeing 707 Jet Stratoliner,[1] by *J. E. Steiner*, Boeing Airplane Co.

IIIb WEDNESDAY, DECEMBER 3 9:30 a.m.

Jointly with Management and Human Factors Society of America

See Management III

IVa WEDNESDAY, DECEMBER 3 2:30 p.m.

Jointly with Gas Turbine Power

The Engineering Development of the Vickers Vanguard,[1] by *D. J. Lambert*, Vickers-Armstrongs (Aircraft) Ltd., Weybridge, Surrey, England

The Rolls-Royce Dart—Past, Present, and Future,[1] by *Bernard Lang*, Rolls-Royce of Canada Ltd., Montreal, Que., Canada

The F-27 Project Transport,[1] by *W. H. Arata, Jr.*, Fairchild Engine & Airplane Corp.

IVb WEDNESDAY, DECEMBER 3 2:30 p.m.

Jointly with Management and Human Factors Society of America

Advanced Concepts and Trends in Human Engineering,[1] by *P. M. Fitts*, Univ. of Michigan

Relations Between Weapon-System Design and Training Program,[1] by *C. P. Seitz*, Grumman Aircraft Engrg. Corp.

Human-Factors Aspects of Man in Space Programs,[1] by *W. F. Grether*, Wright Air Development Center

[1] Paper not available—see box on this page.

V WEDNESDAY, DECEMBER 3 8:00 p.m.

Panel Discussion on the TU-104

Developing the Electra for Airline Operation,[1] by *C. F. Schmidt*, Lockheed Aircraft Corp.

How Design Carry-Over and Basic Technical Evaluation Designed the DC-8 Air-Conditioning, Pressurization, and Ice-Protection Systems,[1] by *W. W. Reaser*, Douglas Aircraft Co., Inc.

VIa THURSDAY, DECEMBER 4 9:30 a.m.

Jointly with Machine Design, Production Engineering, and Instruments and Regulators

Continuous Path Numerical Control, by *W. M. Webster*, Wright-Patterson AFB (Paper No. 58—A-162)

Automatic Programming Methods for Numerical Control of Machine Tools,[1] by *Joseph Crabtree*, Remington Rand Univac

A Progress Report on the 2D-APT-2 Joint Effort for Automatic Programming of Numerically Controlled Machine Tools,[1] by *D. T. Ross*, M.I.T.

Operating Experience—Airframe Components,[1] by *J. J. Childs*, Republic Aviation Corp.

Thermal Stresses in Missile-Nose Cones,[1] by *R. M. Christensen*, Graduate Student, Yale Univ. (formerly with Convair)

A Note on Propulsion Efficiency,[1] by *G. M. Dusinberre*, Pennsylvania State Univ.

Extrapolating Sink-Speed Requirements for Carrier Based Aircraft,[1] by *J. de S. Coutinho*, Grumman Aircraft Engrg. Corp.; Poly. Inst. of Brooklyn, and *Nathan Lichter*, Grumman Aircraft Engrg. Corp.

VIb THURSDAY, DECEMBER 4 9:30 a.m.

Thermodynamic Considerations of Metal Containing Fuels for Jet Aircraft,[1] by *J. R. Branstetter*, NACA, Lewis Flight Propulsion Lab.

Paper on Effects of Cracks on Static Strength,[1] by *A. J. McEvily, Jr.*, Langley Field, Va.

VIIa THURSDAY, DECEMBER 4 2:30 p.m.

A Management Appraisal of the Department of Defense Programs for VTOL/STOL Aircraft,[1] by *C. F. Horton*, Office of the Assistant Secretary of Defense, and *D. M. Thompson*, Office of Chief of Transportation

Design Aspects and Flight Testing the Vertol 76 Tilt Wing VTOL Research Aircraft,[1] by *P. J. Dancik* and *W. B. Peck*, Vertol Aircraft Corp.

Why Free Turbines?[1] by *D. P. Edkins*, Gen. Elec. Co.

VIIb THURSDAY, DECEMBER 4 2:30 p.m.

Jointly with Machine Design, Production Engineering, and Instruments and Regulators

The Operating Experience on Aircraft Production,[1] by *W. D. Beeby*, Boeing Airplane Co.

Discrete-Positioning System Experience—Aircraft Industry,[1] by *W. M. Stocker, Jr.*, McGraw-Hill Publishing Co., Inc.

Automatic Approach Using Numerical Control,[1] by *R. K. Sedgwick*, Kearney & Trecker Corp.

Retrofit Applications of Numerical Controls to Existing Machines,[1] by *P. D. Tilton*, Stanford Research Inst.

VIII FRIDAY, DECEMBER 5 9:30 a.m.

Jointly with Instruments and Regulators

Investigation of Steady-State Anisoelastic Torques in Gimbal Systems Under Vibration,[1] by *R. J. Vaccaro* and *D. D. Martin*, Sperry Gyroscope Co.

Nondimensional Performance Characteristics of a Family of Gyro-Wheel-Drive Hysteresis Motors,[1] by *W. G. Denhard* and *D. C. Whipple*, M.I.T.

Characteristics of a Self-Lubricated Step-Thrust Pad of Infinite Width With Compressible Lubricant,[1] by *K. C. Kochi*, North American Aviation

BOILER FEEDWATER STUDIES SESSIONS

I MONDAY, DECEMBER 1 9:30 a.m.

Jointly with Power

Some Physiochemical Phenomena in Supercritical Water,[1] by *W. A. Keilbaugh*, *F. J. Pocock*, and *N. L. Dickinson*, The Babcock & Wilcox Co.

Thermiatrics, the Diseases of High-Temperature Boilers,[1] by *D. E. Noll*, Hall Labs., Div. of Hagan Chemicals & Controls, Inc.

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Copies of unnumbered papers, listed in this program, *are not available* in advance of the meeting because the review of these manuscripts had not been completed when the program went to press.

The January, 1959, issue of Mechanical Engineering will contain a complete listing of all available papers.

Organic Acids for Chemical Cleaning of Power-Plant Equipment,[1] by *C. M. Loucks*, The Dow Chemical Co., *E. B. Morris*, American Electric Power Service Corp., and *E. A. Pirch*, The Babcock & Wilcox Co.

II MONDAY, DECEMBER 1 2:30 p.m.

Jointly with Power

One Utility's Experience With Filming Amines,[1] by *J. P. White*, Arkansas Power & Light Co.

Trace Concentrations of Octadecylamine and Some of Its Degradation Products,[1] by *G. L. Hopps*, *M. E. Getz*, and *A. A. Berk*, U. S. Bureau of Mines

Experiences With Cyclohexylamine in the Condensate—Feed-Water Systems of High-Pressure Boilers,[1] by *P. C. Fritz* and *I. B. Dick*, Consolidated Edison Co. of N. Y., Inc.

CORROSION AND DEPOSITS SESSION

I TUESDAY, DECEMBER 2 9:30 a.m.

Jointly with Fuels

See Fuels III

EDUCATION SESSION

I THURSDAY, DECEMBER 4 2:30 p.m.

What Is the Profession of Mechanical Engineering?

The Profession of Mechanical Engineering, by *M. P. O'Brien*, Univ. of California

Title of paper to be announced, *J. H. Keenan*, M.I.T.

EFFECT OF TEMPERATURE SESSION

I MONDAY, DECEMBER 1 9:30 a.m.

Jointly with Metals Engineering

See Metals Engineering Ia

II TUESDAY, DECEMBER 2 9:30 a.m.

Jointly with Metals Engineering

See Metals Engineering III

III TUESDAY, DECEMBER 2 2:30 p.m.

Jointly with Metals Engineering

See Metals Engineering IV

FLUID METERS SESSION

I THURSDAY, DECEMBER 4 2:30 p.m.

Electromagnetic Flowmeter Primary Elements, by *V. P. Head*, Fischer & Porter Co. (Paper No. 58—A-126)

Cavitation Effect on the Discharge Coefficient of the Sharp-Edged Plate, by *F. Numachi*, Tohoku Univ., Sendai, Japan; *M. Yamabe*, Hitachi Ltd., Hitachi, Japan; and *R. Oba*, Tohoku Univ., Sendai, Japan (To be presented by *D. M. Stough*, Hagan Chemicals & Controls, Inc.) (Paper No. 58—A-93)

FUELS SESSION

I MONDAY, DECEMBER 1 9:30 a.m.

Jointly with Furnace Performance Factors

See Furnace Performance Factors

II MONDAY, DECEMBER 1 2:30 p.m.

Induced Air Flows in Fuel Sprays,[1] by *Hikmet Binark* and *W. E. Rans*, Pennsylvania State Univ.

The Effect of Ultrasonic Energy Upon Evaporation of Fuel Drops,[1] by *W. Mirsky* and *J. A. Bolt*, Univ. of Michigan

The Uses of Nuclear Energy for Process Heat,[1] by *Harry Perry*, U. S. Bureau of Mines

Practical Aspects of Fuel Cells,[1] by *Everett Gorin*, Consolidation Coal Co.

III TUESDAY, DECEMBER 2 9:30 a.m.

Jointly with Corrosion and Deposits

Coal Cleaning in Relation to Sulfur Reduction in Steam Coals, by *H. J. Rose* and *R. A. Glenn*, Bituminous Coal Research, Inc. (Paper No. 58—A-147)

Dust-Collector Maintenance Testing, Etc.,[1] by *W. E. Archer*, Western Precipitation Corp.

A Summary of Available Information on Corrosion and Deposits From Combustion Gases With Recommendations for Further Research,[1] by *B. A. Landry*, Battelle Memorial Inst.

IV TUESDAY, DECEMBER 2 2:30 p.m.

Jointly with Power

Symposium: Flame-Failure Protection for Large Boilers

Need for and Requirements of Flame-Failure-Protection Equipment for Oil, Coal, and Gas,[1] by *J. B. Smith*, Associated Factory Mutual Insurance Companies (To be discussed by *L. W. Lemon*, Public Service Electric & Gas Co.)

Equipment Available for Flame-Failure Protection for Oil, Coal, and Gas,[1] by *K. R. Blaine*, Fireye, Div. of Electronics Corp. of America (To be discussed by *Alexander Bogot*, Combustion Engineering, Inc.)

Compatability of Protection Equipment and Firing Equipment for Oil and Gas,[1] by *Ross Forney*, Forney Engineering Co. (To be discussed by *Earle C. Miller*, Riley Stoker Corp.)

The Application of Existing Flame-Protection Equipment to Oil and Gas Burners,[1] by *W. F. Lange* and *John Dunn*, Peabody Engineering Corp. (To be discussed by *F. Ceely*, Foster Wheeler Corp.)

Combustion Safeguards for Large Boilers Fired by Coal, Oil, and Gas,[1] by *A. J. Poole*, The Babcock & Wilcox Co. (To be discussed by *R. H. Pecstein*, American Electric Power Service Corp.)

V THURSDAY, DECEMBER 4 2:30 p.m.

Jointly with Process Industries

See Process Industries II

FURNACE PERFORMANCE FACTORS SESSION

I MONDAY, DECEMBER 1 9:30 a.m.

Jointly with Fuels

Symposium: Furnace-and-Burner Model Testing

The Aerodynamic Approach to Furnace Design, by *J. H. Chesters*, The United Steel Companies Ltd., Moorgate, Rotherham, England (Paper No. 58—A-72)

Use of Flow Models for Boiler-Furnace Design, by *R. W. Curtis* and *L. E. Johnson*, The Babcock & Wilcox Co. (Paper No. 58—A-120)

Use of Models for Studying Coal-Burner Performance, by *G. C. Whitney*, Foster Wheeler Corp. (Paper No. 58—A-95)

Basic Principles of Combustion-Model Research, by *A. A. Putnam* and *E. W. Ungar*, Battelle Memorial Inst. (Paper No. 58—A-73)

GAS TURBINE POWER SESSIONS

I TUESDAY, DECEMBER 2 9:30 a.m.

Flow-Induced Noise in Heat Exchangers, by *A. A. Putnam*, Battelle Memorial Inst. (Paper No. 58—A-103)

A Simplified Regenerator Theory, by *W. F. Schalkwijk*, N. V. Philips' Gloeilampenfabrieken, Eindhoven, The Netherlands (Paper No. 58—A-135)

II TUESDAY, DECEMBER 2 2:30 p.m.

Development of a Smooth Running Double Spool Gas-Turbine Rotor System With Concentric Shafts in Journal Bearings[1]

The Effect of Fuel Types and Admission Method Upon Combustion Efficiency, by *H. N. McManus, Jr.*, Cornell Univ., and *W. E. Ibele* and *T. E. Murphy*, Univ. of Minnesota (Paper No. 58—A-128)

III TUESDAY, DECEMBER 2 8:00 p.m.

Marine Symposium: Operating Experience With Gas Turbines and Free-Piston Gas Turbines at Sea

IV WEDNESDAY, DECEMBER 3 9:30 a.m.

1958 Gas-Turbine Progress Report—Part 1

1958 Gas-Turbine Progress Report—Introduction, by *R. Tom Sawyer*, consultant, Ho-Ho-Kus, N. J. (Paper No. 58—A-46A)

1958 Gas Turbine Progress Report—Gas-Turbine Materials, by *A. W. Herbenar* and *G. R. Heckman*, Gen. Elec. Co. (Paper No. 58—A-46B)

1958 Gas-Turbine Progress Report—Turbine Cooling, by *J. B. Esgar*, National Aeronautics and Space Agency (formerly NACA) (Paper No. 58—A-46C)

1958 Gas-Turbine Progress Report—Fuels, by *A. D. Foster*, Gen. Elec. Co. (Paper No. 58—A-46D)

1958 Gas-Turbine Progress Report—Cycle Components, by *P. F. Martinussi*, Stevens Inst. of Tech. (Paper No. 58—A-46E)

1958 Gas-Turbine Progress Report—Compound Piston and Turbine Engines, by *A. L. London*, Stanford Univ. (Paper No. 58—A-46F)

Va WEDNESDAY, DECEMBER 3 2:30 p.m.

Jointly with Aviation

See Aviation IV

Vb WEDNESDAY, DECEMBER 3 2:30 p.m.

1958 Gas-Turbine Progress Report—Part 2

1958 Gas-Turbine Progress Report—Automotive, by *F. L. Schwartz*, Univ. of Michigan (Paper No. 58—A-46I)

1958 Gas-Turbine Progress Report—Railroad, by *P. R. Broadley* and *W. M. Meyer*, Bituminous Coal Research, Inc.; *D. S. Neuhart*, Union Pacific RR; *E. L. Barlow*, Curtiss-Wright Corp.; *R. C. Bond*, British Transport Commission, London, England; *D. S. D. Williams*, The Oil Engine & Gas Turbine, London, England; and *B. W. C. Cooke*, *The Railway Gazette*, London, England (Paper No. 58—A-46J)

1958 Gas-Turbine Progress Report—Marine, by *J. W. Sawyer* and *Harry M. Simpson*, U. S. Bureau of Ships (Paper No. 58—A-46K)

1958 Gas-Turbine Progress Report—Industrial and Central Station, by *B. G. A. Skrotzki*, McGraw-Hill Publishing Co., Inc. (Paper No. 58—A-46L)

VI WEDNESDAY, DECEMBER 3 8:00 p.m.

1958 Gas-Turbine Progress Report—Part 3

1958 Gas-Turbine Progress Report—Nuclear Power, by *R. P. Godwin*, U. S. Atomic Energy Commission and *E. S. Dennison*, Gen. Dynamics Corp. (Paper No. 58—A-46M)

1958 Gas-Turbine Progress Report—Aviation, by *O. E. Lancaster*, Pennsylvania State Univ. (Paper No. 58—A-46G)

1958 Gas-Turbine Progress Report—Rocket Turbines, by *O. E. Lancaster* and *C. J. Bates*, Pennsylvania State Univ. (Paper No. 58—A-46H)

VII FRIDAY, DECEMBER 5 9:30 a.m.

Jointly with Hydraulic

See Hydraulic IXb

VIII FRIDAY, DECEMBER 5 2:30 p.m.

Jointly with Hydraulic

See Hydraulic Xb

HEAT TRANSFER SESSIONS

I MONDAY, DECEMBER 1 9:30 a.m.

Heat Transfer in Ducted Flows

The Effect of Surface Roughness on the Convection Heat-Transfer Coefficient for Fully Developed Turbulent Flow in Ducts With Uniform-Heat Flux, by *R. T. Lamcet*, North American Aviation, Inc. (Paper No. 58—A-122)

The Influence of Radiation on Convection in Noncircular Ducts, by *T. F. Irvine, Jr.*, Univ. of Minnesota (Paper No. 58—A-155)

A Variational Method for Fully Developed Laminar Heat Transfer in Ducts, by *E. M. Sparrow* and *R. Siegel*, NACA, Lewis Flight Propulsion Lab. (Paper No. 58—A-92)

II MONDAY, DECEMBER 1 2:30 p.m.

Condensation and Mixed-Phase Heat Transfer

Laminar-Film Condensation of Pure Saturated Vapors at Rest on Nonisothermal Surfaces,[1] by *Kamal Eldin Hassan*, Univ. of Khartoum, Khartoum, Sudan

A Theory of Rotating Condensation, by *E. M. Sparrow* and *J. L. Gregg*, NACA, Lewis Flight Propulsion Lab. (Paper No. 58—A-70)

Heat Transfer to Water Coolant in Capillary Tubes for the Liquid, Mixed, and Vapor Phases,[1] by *E. W. Schwartz*, Convair

[1] Paper not available—see box on page 117.

III TUESDAY, DECEMBER 2 9:30 a.m.

Jointly with Aviation

The Calculations of Turbulent Skin Friction Around Blunt Bodies of Revolution at High Speed,[1] by *P. K. Chang*, The Catholic Univ. of America

Friction and Heat Transfer of Compressible Flow Into an Infinite Lattice of Flat Plates,[1] by *S. L. Soo*, Princeton Univ.

Heat-Transfer Cylinders in Subsonic Flow,[1] by *L. V. Baldwin*, NACA, Lewis Flight Propulsion Lab.

IV TUESDAY, DECEMBER 2 2:30 p.m.

Jointly with Aviation

Adiabatic Wall Temperatures Downstream of a Single Tangential Injection Slot, by *J. H. Chin, S. C. Skirvin, L. E. Hayes*, and *A. H. Silver*, Gen. Elec. Co. (Paper No. 58—A-107)

Interferometric Investigation of the Stability of a Turbulent Boundary Layer With Mass Addition,[1] by *D. S. Hacker*, Armour Research Foundation

The Emissivity and Absorptivity Values for Parachute Fabrics, by *J. P. Hartnett, E. R. G. Eckert*, and *R. Birkebak*, Univ. of Minnesota (Paper No. 58—A-125)

V WEDNESDAY, DECEMBER 3 9:30 a.m.

Laminar Heat-Transfer in Rectangular Channels, by *L. S. Han*, Ohio State Univ. (Paper No. 58—A-124)

Heat Transfer to Water in Thin Rectangular Channels, by *S. Levy, R. A. Fuller*, and *R. D. Niemi*, Gen. Elec. Co. (Paper No. 58—A-127)

Study of Existing Data for Heating of Air and Water Inside Tubes,[1] by *M. Ali-Arabi*, Cairo, Egypt

VI WEDNESDAY, DECEMBER 3 2:30 p.m

Transient Heat Flow

Use of Integral Methods in Transient Heat-Transfer Analysis,[1] by *W. C. Reynolds*, Stanford Univ., and *T. A. Dolton*, Lockheed Missile Systems Div.

Liebmann Network Approximations to One-Dimensional Transient Heat-Conduction Problems,[1] by *R. P. Benedict*, Westinghouse Elec. Corp.

Combined Geometric and Network Analog Computer for Transient Heat Flow, by *Victor Paschkis*, Columbia Univ. (Paper No. 58—A-69)

VII THURSDAY, DECEMBER 4 9:30 a.m.

Natural Convection Heat Transfer in Closed Vessels With Internal-Heat Sources,[1] by *F. G. Hammitt*, Univ. of Michigan

Heat Transfer Between Concentric Rotating Cylinders, by *S. Bjorklund*, Shell Development Co. and *W. Kays*, Stanford Univ. (Paper No. 58—A-99)

Heat Transfer From an Annular Fin of Constant Thickness, by *H. H. Keller* and *E. V. Somers*, Westinghouse Elec. Corp. (Paper No. 58—A-116)

VIII THURSDAY, DECEMBER 4 2:30 p.m.

Jointly with Maintenance

Symposium: Fouling, Cleaning, and Maintenance of Heat Exchangers

Fouling and Cleaning of Power-Plant Heat Exchangers,[1] by *Tom Miskimen* and *C. E. Brune*, American Elec. Power Service Corp.

Hydraulic Jetting Tools for Cleaning Heat Exchangers,[1] by *B. L. Canady*, Cowell, Inc.

Cleaning of Heat Exchangers,[1] by *Guerard Mackey*, E. I. du Pont de Nemours & Co., Inc.

IX FRIDAY, DECEMBER 5 9:30 a.m.

Growth of Bubbles in a Liquid of Initially Nonuniform Temperature, by *S. G. Bankhoff*, Rose Poly. Inst., and *R. D. Mikesell*, Univ. of Illinois (Paper No. 58—A-105)

An Experimental and Analytical Study of Vortex-Flow Temperature Separation by Superposition of Spiral and Axial Flows, by *J. E. Lay*, Michigan State Univ. (Paper No. 58—A-90)

Transient Temperature Responses and Elastic-Thermal Stresses on Asymmetrically Heated Plates and Shells,[1] by *Y. S. Tang*, Westinghouse Elec. Corp.

X FRIDAY, DECEMBER 5 2:30 p.m.

Heat Transfer in Biotechnology

Full-Scale Human-Body Model Thermal Exchange Compared With Equational Condensations of Human-Body Calorimetric Data,[1] by *L. P. Herrington*, John B. Pierce Foundation

An Electrical Analogue for Studying Heat Transfer in Dynamic Situations,[1] by *A. H. Woodcock H. L. Thwaites*, and *J. R. Breckenridge*, Quartermaster Research & Engineering Center

Temporal Aspects of Temperature Sensation,[1] by *E. Hendler*, U. S. Naval Air Development Center, and *J. D. Hardy*, Univ. of Pennsylvania

The Production of Burns by Thermal Radiation of Medium Intensity,[1] by *A. M. Stoll* and *L. C. Green*, U. S. Naval Air Development Center

HYDRAULIC SESSIONS

Ia MONDAY, DECEMBER 1 9:30 a.m.

Jointly with Instruments and Regulators

Fluid Mechanics—1

Centrifugal Manometer,[2] by *J. F. Kemp*, National Mechanical Inst., South African Council for Scientific & Industrial Research, Pretoria, South Africa (Paper No. 58—A-111)

Prediction of Critical Pressures for the Two-Phase Flow of Saturated Water in Pipes, by *D. O. Stuart*, Boeing Airplane Co., and *Glen Murphy*, Iowa State College (Paper No. 58—A-112)

The Skewed Boundary Layer, by *E. S. Taylor*, M.I.T. (Paper No. 58—A-113)

Coefficients of Discharge of Short Pipe Orifices for Incompressible Flow at Reynolds Numbers Less Than One,[2] by *R. P. Miller*, Gen. Elec. Co., and *I. V. Nemecek*, Univ. of Kansas (Paper No. 58—A-106)

Ib MONDAY, DECEMBER 1 9:30 a.m.

Cavitation and Pumping Machinery—1

Calculation of Radial-Flow-Impeller Performance Curves by the Modified Aerofoil Theory, by *André Kovats*, Foster Wheeler Corp. (Paper No. 58—A-86)

Direct Measurement of Net Positive Suction Head, by *R. B. Jacobs* and *K. B. Martin*, National Bureau of Standards, and *R. J. Hardy*, U. S. Naval Ordnance Lab. (Paper No. 58—A-38)

IIa MONDAY, DECEMBER 1 2:30 p.m.

Jointly with Applied Mechanics

Fluid Mechanics—2

A Simple Approach to an Approximate Two-Dimensional Cascade Theory, by *M. J. Schilhansl*, Brown Univ. (Paper No. 58—A-23)

Velocity and Temperature-Fluctuation Measurements in a Turbulent Boundary Layer Downstream of a Stepwise Discontinuity in Wall Temperature, by *D. S. Johnson*, Bell Telephone Labs., Inc. (Paper No. 58—A-81)

Some Preliminary Results of Visual Studies of the Flow Model of the Wall Layers of the Turbulent Boundary Layer, by *S. J. Kline* and *P. W. Runstadler*, Stanford Univ. (Paper No. 58—A-64)

Ducted Fan-Design Theory,[2] by *C. G. Van Niekerk*, National Mechanical Engineering Research Inst., South African Council for Scientific & Industrial Research, Pretoria, South Africa (Paper No. 58—A-4)

IIb MONDAY, DECEMBER 1 2:30 p.m.

Cavitation and Pumping Machinery—2

Transitional Phenomena in Ultrasonic Shock Waves Emitted by Cavitation on Hydrofoils, by *F. Numachi*, Tohoku Univ., Sendai, Japan (To be presented by *J. W. Daily*, M.I.T.) (Paper No. 58—A-117)

Cavitation and NPSH Requirements of Various Liquids, by *Victor Salemann*, Worthington Corp. (Paper No. 58—A-82)

III TUESDAY, DECEMBER 2 9:30 a.m.

Fluid Mechanics—3

The Unsteady Wake Interaction in Turbomachinery and Its Effect on Cavitation, by *H. Yeh* Univ. of Pennsylvania, and *J. J. Eisenhuth*, Pennsylvania State Univ. (Paper No. 58—A-114)

An Analysis of Axial Compressor Cascade Aerodyanmics, Part 1—Potential Flow Analysis With Complete Solutions for Symmetrically Cambered Airfoil Families, by *G. L. Mellor*, Princeton Univ. (Paper No. 58—A-83)

An Analysis of Axial Compressor Cascade Aerodynamics, Part 2—Comparison of Potential Flow Results With Experimental Data, by *G. L. Mellor*, Princeton Univ. (Paper No. 58—A-84)

The Central Unresolved Fluid-Mechanics Problems of the Mechanical Engineer,[1] by *S. J. Kline*, Stanford Univ., and *R. C. Dean, Jr.*, Ingersoll-Rand Co.

IV TUESDAY, DECEMBER 2 2:30 p.m.

Fluid Mechanics—4

Loss and Stall Analysis in Compressor Cascades, by *S. Lieblein*, NACA, Lewis Flight Propulsion Lab. (Paper No. 58—A-91)

Stall Prediction in Gas-Turbine Engines, by *R. J. Lubick* and *L. E. Wallner*, NACA, Lewis Flight Propulsion Lab. (Paper No. 58—A-133)

On the Nature of Stall,[1] by *S. J. Kline*, Stanford Univ.

Optimum Design of Straight Walled Diffusers, by *S. J. Kline, D. E. Abbott*, and *R. W. Fox*, Stanford Univ. (Paper No. 58—A-137)

V WEDNESDAY, DECEMBER 3 9:30 a.m.

Waterhammer

Large Water-Level Displacements in the Simple Surge Tank, by *A. W. Marris*, The Univ. of British Columbia, Vancouver, B. C., Canada (Paper No. 58—A-29)

Applications of Computer and Model Studies to Problems Involving Hydraulic Transients, by *I. W. McCaig* and *F. H. Jonker*, H. G. Acres & Co., Ltd., Consulting Engineers, Niagara Falls, Ont., Canada (Paper No. 58—A-101)

VIa WEDNESDAY, DECEMBER 3 2:30 p.m.

Hydraulic Prime Movers—1

Experience in the Use of the Gibson Method of Water Measurements for Efficiency Tests of Hydraulic Turbines, by *N. R. Gibson*, consulting engineer, Niagara Falls, N. Y. (Paper No. 58—A-78)

Welded Spiral Cases From the Manufacturer's Point of View, by *J. Fisch*, S. Morgan Smith Co. (Paper No. 58—A-60)

Free Discharge Through a Hydraulic Turbine Distributor, Case, and Draft Tube, by *R. A. Sutherland*, Ebasco Services, Inc. (Paper No. 58—A-76)

VIb WEDNESDAY, DECEMBER 3 2:30 p.m.

Fluid Mechanics—5

VIIa THURSDAY, DECEMBER 4 9:30 a.m.

Fluid Mechanics Symposium—1

VIIb THURSDAY, DECEMBER 4 9:30 a.m.

Hydraulic Prime Movers—2

Deriaz-Type Reversible Pump-Turbine at Niagara (Ont.) Storage Installation, by *P. Deriaz*, The English Electric Co., Ltd., Rugby, England, and *J. G. Warnock*, English Electric Canada Div. of John Inglis Co., Ltd., Toronto, Ont., Canada (Paper No. 58—A-108)

Reversible Pump-Turbines at Sir Adam Beck Niagara Pumping-Generating Station, by *A. E. Aeberli*, Hydro-Electric Power Commission of Ontario, Toronto, Ont., Canada (Paper No. 58—A-77)

Some Hydraulic Features of Puntledge Generating Plant, by *A. W. Lash*, British Columbia Power Commission, Victoria, B. C., Canada, and *R. E. Passmore*, Canadian Allis-Chalmers Ltd., Lachine, Que., Canada (Paper No. 58—A-100)

VIII THURSDAY, DECEMBER 4 2:30 p.m.

Fluid Mechanics Symposium—2

IXa FRIDAY, DECEMBER 5 9:30 a.m.

Fluid Mechanics Symposium—3

[1] Paper not available—see box on page 117.

IXb FRIDAY, DECEMBER 5 9:30 a.m.

Jointly with Gas-Turbine Power

Compressor Symposium

Panel Members

Howard Duguid, Shell Chemical Corp.

H. D. Gibson, Esso Research & Engineering Co.

K. N. Thompson, Socony Mobil Oil Co., Inc.

William Allison, Humble Oil & Refining Co.

J. N. Vivien, National Advisory Committee for Aeronautics

J. C. Erskine, Gulf Oil Corp.

Mr. Schults, National Advisory Committee for Aeronautics

Xa FRIDAY, DECEMBER 5 2:30 p.m.

Fluid Mechanics Symposium—4

Xb FRIDAY, DECEMBER 5 2:30 p.m.

Jointly with Gas-Turbine Power

Compressors

Radial Equilibrium in Supersonic Compressors, by *A. G. Hammitt* and *S. M. Bogdonoff*, Princeton Univ. (Paper No. 58—A-101)

Résumé of the Supersonic Compressor Research at NACA Lewis Laboratory,[1] by *W. W. Wilcox, E. R. Tysl*, and *M. J. Hartmann*, NACA, Lewis Flight Propulsion Lab.

INSTRUMENTS AND REGULATORS SESSIONS

Ia MONDAY, DECEMBER 1 9:30 a.m.

Jointly with Hydraulic

See Hydraulic Ia

Ib MONDAY, DECEMBER 1 9:30 a.m.

Educating Qualified Semiprofessional Specialists in Control Technology, by *L. E. Slater*, Foundation for Instrumentation Education & Research

An Experiment in Control-Engineering Education, by *J. H. Westcott*, Imperial College of Sci. & Tech., London, England (Paper No. 58—A-164)

Building an Education in IRD,[1] by *C. R. Otto*, E. I. du Pont de Nemours & Co., Inc.

II MONDAY, DECEMBER 1 2:30 p.m.

Control Technology as a Unifying Tool in Engineering Education, by *Gerhard Reethof*, Vickers, Inc.

Generalizing the Concepts of Power Transport and Energy Ports for Systems Engineering, by *H. M. Paynter*, M.I.T.

Automatic Control in Mechanical Engineering,[1] by *D. P. Eckman* and *Irving Lefkowitz*, Case Inst. of Tech.

III TUESDAY, DECEMBER 2 9:30 a.m.

Dynamic Analysis of the Sea Master Stabilizer Position Control,[1] by *M. A. Papillo*, Martin Co.

Statistical Optimization of Regulators Employing a Binary Error Criterion, by *J. H. Milsum*, National Research Council, Ottawa, Ont., Canada (Paper No. 58—A-71)

An Introduction to the Time-Modulated Acceleration Switching Electrohydraulic Servomechanism, by *S. A. Murtaugh*, Cornell Aeronautical Lab. (Paper No. 58—A-159)

IV TUESDAY, DECEMBER 2 2:30 p.m.

The Response of Pneumatic Transmission Lines to Step Inputs, by *C. B. Schuder*, Fisher Governor Co., and *R. C. Binder*, Purdue Univ. (Paper No. 58—A-136)

Analysis of a Pneumatic Force-Balance Controller,[1] by *J. L. Pritchard*, The Foxboro Co.

Static and Dynamic-Control Characteristics of Flapper-Nozzle Valves, by *Tsung-Ying Feng*, Bell Aircraft Corp. (Paper No. 58—A-160)

Application and Analysis of a Computer-Control System,[1,2] by *Irving Lefkowitz* and *D. P. Eckman*, Case Inst. of Tech.

[1] Paper not available—see box on page 117.

V WEDNESDAY, DECEMBER 3 9:30 a.m.

Panel Discussion: Instrumentation in the USSR

(American Automatic Control Council Members' impressions of their recent trip to Russia)

H. Ziebolz, General Precision Equipment Corp.

E. P. Epler, Oak Ridge National Lab.

H. W. Mergler, Case Inst. of Tech.

N. Cohn, Leeds & Northrup Co.

VI WEDNESDAY, DECEMBER 3 2:30 p.m.

Jointly with Mechanical Pressure Elements

See Mechanical Pressure Elements

VII THURSDAY, DECEMBER 4 9:30 a.m.

Jointly with Aviation, Machine Design, and Production Engineering

See Aviation VIIa

VIII THURSDAY, DECEMBER 4 2:30 p.m.

Jointly with Aviation, Machine Design, and Production Engineering

See Aviation VIIb

JUNIOR SESSION

I TUESDAY, DECEMBER 2 8:00 p.m.

Panel and Group Discussion

The Young Engineer—Which Road for His Future

Personal Assets and Liabilities of Engineers Which Determine Their Future, by *Harry Sherman*, consulting psychologist, New York, N. Y.

Adaptability—Key to Survival, by *J. de S. Coutinho*, Grumman Aircraft Corp.; Polytechnic Inst. of Brooklyn

The Tide Runs to Specialization, by *H. A. Rothbart*, City College of N. Y.

LUBRICATION SESSIONS

I MONDAY, DECEMBER 1 9:30 a.m.

Jointly with Plastic Flow of Metals, Metals Engineering, Applied Mechanics, and Production Engineering

See Plastic Flow of Metals

II WEDNESDAY, DECEMBER 3 9:30 a.m.

Jointly with Maintenance

Fatigue Life and Testing of Rolling Element Bearings

Experimental Laboratory Studies of Bearing Fatigue,[1] by *R. A. Baughman*, Gen. Elec. Co.

Optimum Methods for Oil-Jet Lubricating Jet-Engine-Mainshift Ball Bearings,[1] by *R. E. Murtesa*, Gen. Motors Corp.

III WEDNESDAY, DECEMBER 3 2:30 p.m.

Vibrations and Elasticity of Rolling Element Bearings

Characteristics of Smooth Running Anti-Friction Bearings,[1] by *T. W. Morrison* and *T. Tallian*, SKF Industries, Inc.

Energy Loss of Ball Rolling on Plates,[1] by *R. C. Drutowski*, Gen. Motors Research Labs.

The Mechanics of Rolling Element Bearing Vibrations,[1] by *T. Tallian* and *Olaf Gustafsson*, SKF Industries, Inc.

IV WEDNESDAY, DECEMBER 3 8:00 p.m.

Symposium: Lubrication Design

What Lubrication Research Advances in 1958 Mean to the Mechanical Engineer,[1] by *H. A. Hartung*, Atlantic Refining Co.

Surface Finish and Clearance Effects on Journal-Bearing-Load Capacity and Friction,[1] by *F. W. Ocvirk* and *G. Du Bois*, Cornell Univ. (Paper No. 58—A-134)

An Analog Study of Levapad Stability,[1] by *D. J. Jay* and *H. W. Peithman, Jr.*, Ford Motor Co.

High-Speed Journal Bearings Using Low-Viscosity Liquid Lubricants,[1] by *L. P. Damratowski, D. Kist*, and *J. R. Shields*, Elliot Co.

V THURSDAY, DECEMBER 4 9:30 a.m.

Lubricant-Film Thickness Between Gear Teeth and Rolling Surfaces

Measurement of Oil-Film Thickness Between Disks by Electrical Conductivity,[1] by *G. S. A. Shawki* and *S. I. El-Sisi*, Cairo Univ., Giza, Egypt (To be presented by *W. E. Campbell*, Efran Associates)

Performance Characteristics of Lubricating Oil Between Disks,[1] by *G. S. A. Shawki*, and *S. I. El-Sisi*, Cairo Univ., Giza, Egypt

The Measurement of the Oil-Film Thickness Between Gear Teeth,[1] by *A. Cameron*, and *I. O. MacConochie*, Imperial College of London, London, England (Paper No. 58—A-142)

VI THURSDAY, DECEMBER 4 2:30 p.m.

Special Topics in Hydrodynamic Lubrication

Some Instabilities and Operating Characteristics of High-Speed Gas-Lubricated Journal Bearings,[1] by *J. Cerubim, G. K. Fisher*, Fairchild Engine & Aeroplane Co., and *D. D. Fuller*, Columbia Univ.

Oscillating Journal Bearing Oil-Film Studies,[1] by *E. K. Gatcombe* and *G. G. Nelson*, U. S. Naval Post Graduate School (Paper No. 58—A-156)

On the Effect of Lubricant Inertia in the Theory of Hydrodynamic Lubrication,[1] by *A. A. Milne*, Thorntonhall, Glasgow, Scotland

VII FRIDAY, DECEMBER 5 9:30 a.m.

Friction and Boundary Lubrication

A Method of Radiotracer Counting for Engine-Wear Determination,[1] by *E. H. Okrent*, Esso Research & Engineering Co.

A Study of Dynamic Friction,[1] by *N. H. Cook*, M.I.T.

Resin-Bonded Tetrafluroethylene Films,[1] by *A. J. Stock*, Acheson Colloids Co.

VIII FRIDAY, DECEMBER 5 2:30 p.m.

Viscoelastic Properties of Lubricants

A Review of Our Knowledge of Viscoelasticity,[1] by *G. J. O'Donnell*, Shell Development Co.

The Effect of Polymer Structure on Viscosity—Shear Characteristics,[1] by *R. M. Jolie, M. R. Fenske*, and *E. E. Klaus*, Pennsylvania State Univ.

The Flow of Lubricating Grease,[1] by *A. W. Sisko*, Standard Oil Co. of Ind.

Student Headquarters

The Dartmouth Room in the Hotel Statler-Hilton will serve as Headquarters for students throughout the meeting. All students will report there for registration. Students are cordially invited to assist in the conduct of the technical sessions by serving as a session aide. Assignments are made in the Dartmouth Room. Coffee will be available and sandwiches will be served at lunch time.

MACHINE DESIGN SESSIONS

I MONDAY, DECEMBER 1 9:30 a.m.

Synthesis of Path-Generating Mechanisms by Means of a Programmed Digital Computer, by *Ferdinand Freudenstein,* Columbia Univ., and *G. N. Sandor,* Time, Inc. (Paper No. 58—A-85)

Four-Bar Linkages—Approximate Synthesis, by *R. T. Hinkle,* Michigan State Univ., and *W. W. Worthley,* United Aircraft Corp. (Paper No. 58—A-130)

Synthesis of the Four-Bar Linkage to Match Prescribed Velocity Ratios, by *Philip Barkan* and *E. J. Tuohy,* Gen. Elec. Co. (Paper No. 58—A-115)

II MONDAY, DECEMBER 1 2:30 p.m.

Lateral Vibrations in Reciprocating Machinery, by *C. M. Lowell,* Worthington Corp. (Paper No. 58—A-79)

History of the Development, Design, Fabrication, and Proof Testing of the Atomic Blast Simulator for the U. S. Naval Civil Engineering Laboratory,[1] by *W. W. Boynton,* Boynton Associates

Designing to Reduce Down Time, by *D. I. Dumond,* The Cross Co. (Paper No. 58—A-131)

IIIa TUESDAY, DECEMBER 2 9:30 a.m.

An Application of Statistics to the Dimensioning of Machine Parts, by *M. F. Spotts,* Northwestern Univ. (Paper No. 58—A-44)

The Dynamic Analysis and Design of Relatively Flexible Cam Mechanisms Having More Than One Degree of Freedom,[1] by *R. C. Johnson,* Yale Univ.

Design of "Zytel" Nylon Resin Spur Gears,[1] by *K. W. Hall* and *H. H. Alvord,* Univ. of Michigan

IIIb TUESDAY, DECEMBER 2 9:30 a.m.

Jointly with Production Engineering and Applied Mechanics

See Production Engineering II

IV TUESDAY, DECEMBER 2 2:30 p.m.

A Theory for the Effect of Mean Stress on Fatigue of Metals Under Combined Torsion and Axial Load or Bending, by *W. N. Findley,* Brown Univ. (Paper No. 58—A-61)

An Analysis of Critical Stresses and Mode of Failure of a Wire Rope, by *W. L. Starkey,* Ohio State Univ., and *H. A. Cress,* Battelle Memorial Inst. (Paper No. 58—A-63)

Extension of Holzer-Myklestad-Prohl Calculation of Turborotor Critical Speeds,[1] by *R. L. Urban,* Illinois Inst. of Tech.

Va WEDNESDAY, DECEMBER 3 9:30 a.m.

Jointly with American Society of Tool Engineers

The following papers were originally presented at the ASTE annual meeting May 1-8, 1958, in Philadelphia, Pa.

For Tools and Dies—New Epoxy Fiber Compositions,[1] by *A. P. Mazzucchelli,* Bakelite Co., Div. of Union Carbide Corp.

Frictional Behavior of Metals and Plastics,[1] by *E. J. Weiter,* Marquette Univ., and *A. O. Schmidt,* Kearney & Trecker Corp.; Marquette Univ.

Vb WEDNESDAY, DECEMBER 3 9:30 a.m.

Jointly with Production Engineering

See Production Engineering IV

VIa THURSDAY, DECEMBER 4 9:30 a.m.

Jointly with Aviation, Production Engineering, and Instruments and Regulators

See Aviation VIa

VIb THURSDAY, DECEMBER 4 9:30 a.m.

Jointly with Safety and Production Engineering

See Safety II

Official Notice

ASME Business Meeting

The Annual Business Meeting of the members of The American Society of Mechanical Engineers will be held on Monday afternoon, December 1, 1958, at 4:45 p.m., at the Statler-Hilton Hotel, New York, N. Y., as part of the Annual Meeting of the Society.

Members are urged to attend.

VIIa THURSDAY, DECEMBER 4 2:30 p.m.

Jointly with Aviation, Production Engineering, and Instruments and Regulators

See Aviation VIIb

VIIb THURSDAY, DECEMBER 4 2:30 p.m.

Jointly with Safety and Production Engineering

See Safety III

MAINTENANCE SESSIONS

I WEDNESDAY, DECEMBER 3 9:30 a.m.

Jointly with Lubrication

See Lubrication II

II WEDNESDAY, DECEMBER 3 2:30 p.m.

Jointly with Management

See Management IV

III THURSDAY, DECEMBER 4 9:30 a.m.

Maintenance-Control Center,[1] by *L. G. Stine,* Associated Industrial Consultants

A New Look at Specialized Refractories as Maintenance Tools,[1] by *R. W. Brown,* The Carborundum Co.

MANAGEMENT SESSIONS

Ia TUESDAY, DECEMBER 2 2:30 p.m.

Jointly with Maintenance

The Engineer as an Administrator

Why More Engineers are not Considered for Administrative Positions, by *V. D. Schoeller,* Remington Rand Div. of Sperry-Rand Corp. (Paper No. 58—A-163)

Developing From an Engineer to an Administrator,[1] by *O. J. Sizelove,* Newark College of Engrg.

Value of Engineering Experience in an Administrative Position,[1] by *J. B. Joynt,* N. Y. Central RR

Ib TUESDAY, DECEMBER 2 2:30 p.m.

Jointly with Production Engineering

See Production Engineering III

II TUESDAY, DECEMBER 2 8:00 p.m.

Jointly with Power

See Power IV

III WEDNESDAY, DECEMBER 3 9:30 a.m.

Jointly with Aviation and Human Factors Society of America

Techniques Used in Human-Factors Engineering

Human-Engineering Methods for System Development,[1] by *H. P. Van Cott,* IBM Corp.

Data Collection for the Design and Evaluation of Man-Machine Systems,[1] by *J. H. Ely,* Dunlap & Associates, Inc.

Simulation Techniques in Human-Factors Research,[1] by *C. P. Seitz,* Grumman Aircraft Engrg. Corp.

IV WEDNESDAY, DECEMBER 3 2:30 p.m.

Jointly with Aviation and Human Factors Society of America

See Aviation IVb

MATERIALS HANDLING SESSIONS

I TUESDAY, DECEMBER 2 9:30 a.m.

The Use of Elementary Statistics to Analyze Materials-Handling Problems,[1] by *W. J. Richardson,* Lehigh Univ.

Some New Concepts in the Systems Engineering of Materials-Handling Operations,[1] by *Allan Harvey,* Dasol Corp.

II TUESDAY, DECEMBER 2 2:30 p.m.

Influence of Size on the Rate of Gravity Flow of Spherical Particles,[1] by *Robert LaForge,* Univ. of Tennessee

Engineering for Solids-Bulk Containers, by *R. W. Wesson,* Union Carbide Chemicals Co. (Paper No. 58—A-89)

III WEDNESDAY, DECEMBER 3 9:30 a.m.

Some Considerations in the Life Determination of Lift Trucks, by *R. O. Swalm,* Syracuse Univ. (Paper No. 58—A-88)

British Materials Handling, by *J. C. Somers,* Industrial Products Engrg. Co. (Paper No. 58—A-80)

MECHANICAL PRESSURE ELEMENTS SESSION

I WEDNESDAY, DECEMBER 3 2:30 p.m.

Jointly with Instruments and Regulators

Pressure-Deflection Nonlinearities of Corrugated Diaphragm Capsules,[1] by *W. G. Brombacher* and *C. J. Jenny,* Bendix Aviation Corp.

The Dynamic Response Behavior of Diaphragms in Relation to the Driving Function and Surrounding Media,[1] by *F. F. Liu,* Dresser Dynamics, Inc.

Bending and Stretching of Corrugated Diaphragms, by *R. F. Dressler,* National Bureau of Standards (Paper No. 58—A-62)

Tests on Deflection of Flat Oval Bourdon Tubes, by *G. Kardos,* Aviation Electric Ltd. Montreal, Que., Canada (Paper No. 58—A-67)

Diaphragm-Characteristics Design and Terminology,[2] by *F. B. Newell,* Taylor Instrument Companies

Theory of High-Pressure Bourdon Tubes,[2] by *W. Wuest,* Aerodynamic Research Inst., Göttingen, Germany (Translated by *L. M. Van der Pyl,* Rockwell Manufacturing Co.) (Paper No. 58—A-119)

METALS ENGINEERING SESSIONS

Ia MONDAY, DECEMBER 1 9:30 a.m.

Jointly with Effect of Temperature

Creep of Metals

Creep-Rupture Strength of Austenitic Cr-Ni-Mo Steel in Sheet and Bar Form, by *G. V. Smith, F. Garofalo, R. W. Whitmore,* and *R. R. Burt,* U. S. Steel Corp. (Paper No. 58—A-102)

A General Approach to the Practical Solution of Creep Problems, by *A. Mendelson, M. H. Hirschberg,* and *S. S. Manson,* NACA, Lewis Flight Propulsion Lab. (Paper No. 58—A-98)

Multiaxial Creep Studies on Inconel at 1500 F,[1] by *C. R. Kennedy,* Oak Ridge National Lab.; *W. O. Harms,* Univ. of Tennessee; and *D. A. Douglas,* Oak Ridge National Lab.

Correlation of High-Temperature Creep and Rupture Data, by *Hans Conrad,* Westinghouse Research Labs. (Paper No. 58—A-96)

Comparison of Parameter Methods for Extrapolating High-Temperature Data, by *R. M. Goldhoff,* Gen Elec. Co. (Paper No. 58—A-121)

Ib MONDAY, DECEMBER 1 9:30 a.m.

Jointly with Plastic Flow of Metals, Applied Mechanics, Lubrication, and Production Engineering

See Plastic Flow of Metals

II MONDAY, DECEMBER 1 2:30 p.m.

Irradiation of Haynes 25 and Inconel X Compression Springs in High-Temperature, High-Pressure Water, by *R. L. Mehan,* Gen. Elec. Co. (Paper No. 58—A-94)

Evaluation of Material Wear and Self-Welding in Sodium-Cooled Reactor Systems,[1] by *R. B. Jerman,* Allis-Chalmers Manufacturing Co., *R. C. Williams,* Wisconsin Power & Light Co., and *D. O. Leeser,* Atomic Power Dev. Associates, Inc.

III TUESDAY, DECEMBER 2 9:30 a.m.

Jointly with Effect of Temperature

Thermal Cycling

Thermal-Stress-Ratchet Mechanism in Pressure Vessels, by *D. R. Miller,* Gen. Elec. Co. (Paper No. 58—A-129)

Refractory-Metal Facings for Protection of Metal Surfaces Subjected to Repeated High-Temperature Pulses,[1] by *A. Cohen,* Convair Astronautics, Div. of Gen. Dynamics; and *E. Homer,* Radio Corp. of America

The Failure of Structural Metals Subjected to Strain-Cycling Conditions,[1] by *R. W. Swindeman* and *D. A. Douglas,* Oak Ridge National Lab.

L TUESDAY, DECEMBER 2 12:15 p.m.

Metals Engineering Luncheon

IV TUESDAY, DECEMBER 2 2:30 p.m.

Jointly with Effect of Temperature

Thermal Strain Cycling Workshop

Panel Members

L. F. Coffin, Jr., Gen. Elec. Co.
B. Langer, Westinghouse Elec. Corp.
B. J. Lazan, Univ. of Minnesota
D. A. Douglas, Oak Ridge National Lab.

NUCLEAR ENGINEERING SESSIONS

I MONDAY, DECEMBER 1 9:30 a.m.

Nuclear Energy for Industrial Heat,[1] by *R. R. Tarrice,* Stanford Univ.

The Conversion of High-Energy Radiations to Stored Chemical Energy,[1] by *D. S. Ballantine,* Brookhaven National Lab.

Power From Radioisotopes,[1] by *K. B. Johnson,* The Martin Co.

Conversion of Plasma Energy Into Electrical Energy,[1] by *W. I. Linlor,* Hughes Aircraft Co.

Nonmilitary Uses of Nuclear and Thermonuclear Explosions,[1]

II MONDAY, DECEMBER 1 2:30 p.m.

Jointly with Safety

Studies of Nuclear Accidents in Fast-Power Reactors,[1] by *W. J. McCarthy, R. B. Nicholson, D. Okrent,* and *V. Z. Jankus,* Atomic Power Dev. Associates, Inc.

Sources of Fuel-Element Instability,[1] by *A. H. Willis,* Gen. Elec. Co.

[1] Paper not available—see box on page 117.

A Quantative Approach to Evaluation of Risk in Locating a Reactor on a Given Site,[1] by *H. J. Gomberg,* Univ. of Michigan, and *T. H. Bassett,* Power Reactor Dev. Corp.

Modifications, Improvements, and Simplifications of Environmental Reactor Hazard Evils[1]

The Experience in the U. S. With Reactor Operation and Factor Safeguards,[1] by *C. R. McCullough,* AEC

Critical Flow Velocities for Collapse of Reactor Parallel-Plate Fuel Assemblies,[1] by *D. R. Miller,* Gen. Elec. Co.

III TUESDAY, DECEMBER 2 9:30 a.m.

Scale-Model Tests for Evaluating Outer Containment Structures for Nuclear Reactors,[1] by *W. E. Baker,* Aberdeen Proving Ground

Hydrodynamic Problems of Reactor Containment,[1] by *F. B. Porzel,* Armour Research Foundation

Reactor Containment,[1] *R. O. Brittan,* Argonne National Lab.

Engineering Considerations in Reactor-Pressure Vessels,[1] by *E. C. Miller,* Oak Ridge National Lab.

Vapor Containers for Nuclear Power Plant,[1] by *C. T. Chave,* Stone & Webster Engrg. Corp.

IV TUESDAY, DECEMBER 2 2:30 p.m.

Molten Fluoride Power Reactor,[1] by *H. G. MacPherson,* Oak Ridge National Lab.

The Gas-Cooled Reactor Experiment,[1] by *G. A. Newby,* Aerojet-General Corp.

Design Studies on Heavy Water,[1] by *Michael Petrick,* Argonne National Lab.

V TUESDAY, DECEMBER 2 8:00 p.m.

Summary of Experiments (Thermonuclear) at Oak Ridge,[1] by *H. C. Hoy,* Oak Ridge National Lab.

Thermonuclear Experiments at University of California Radiation Laboratory,[1] by *Charles C. Damm,* Univ. of California

Thermonuclear Experiments at Los Alamos Scientific Laboratory[1]

Thermonuclear Experiments at Princeton University,[1] by *Robert Mills,* Princeton Univ.

OIL AND GAS POWER SESSIONS

I MONDAY, DECEMBER 1 9:30 a.m.

Formation of Pressure Pulses by Exhaust Blowdown, by *A. W. Hussmann,* Pennsylvania State Univ., and *W. A. Pullman,* Rugby College of Engineering Technology, Rugby, England (Paper No. 58—A-145)

Simulation of a Reciprocating Compressor on an Electronic Analog Computer, by *Walter Brunner,* Electronic Associates, Inc. (Paper No. 58—A-146)

II MONDAY, DECEMBER 1 2:30 p.m.

A Study, Using Radioactive Lubricating Oil, of the Rate of Oil Consumption in an Operating Diesel Engine, by *M. Pobereskin* and *D. N. Sunderman,* Battelle Memorial Inst., and *E. J. Fithian,* Cooper-Bessemer Corp. (Paper No. 58—A-143)

Suppression of Engine-Exhaust Noise, by *Roy Kamo,* Armour Research Foundation (Paper No. 58—A-144)

PETROLEUM SESSIONS

I TUESDAY, DECEMBER 2 9:30 a.m.

Storage-Tank-Design Practices to Avoid Brittle Fracture, by *J. S. Clarke* and *T. F. Leahey,* Esso Research & Engrg. Co. (Paper No. 58—A-149)

Design and Analysis of Welded Pressure-Vessel-Skirt Support, by *N. A. Weil* and *J. J. Murphy,* The M. W. Kellogg Co. (Paper No. 58—A-153)

II TUESDAY, DECEMBER 2 2:30 p.m.

Hazards Associated With the Storage of LPG, by *R. B. Jacobs* and *F. A. Upson,* Standard Oil Co. of Ind. (Paper No. 58—A-151)

"H-Iron" Process Uses Refinery Techniques and By-Product Hydrogen, by *F. D. Hoffert, E. A. Kelly,* and *A. M. Squires,* Hydrocarbon Research, Inc. (Paper No. 58—A-158)

PLASTIC FLOW OF METALS SESSION

I MONDAY, DECEMBER 1 9:30 a.m.

Jointly with Metals Engineering, Applied Mechanics, Lubrication, and Production Engineering

Effects of Friction in Plastic Forming of Metals

The Distribution of Contact Pressures in the Rolling of Metals,[1] by *C. W. MacGregor,* consulting engr., Philadelphia, Pa., and *R. B. Palme,* Western Elec. Center

The Effects of Friction in Rolling of Metals,[1] by *M. D. Stone,* United Engrg. & Foundry Co.

The Measurement of Dry Sliding Friction at Elevated Temperatures, by *D. E. Miller,* Dole Valve Co.

Forum—**Promising Avenues for Future Research**

POWER SESSIONS

I MONDAY, DECEMBER 1 9:30 a.m.

Jointly with Boiler Feedwater Studies

See Boiler Feedwater Studies I

II MONDAY, DECEMBER 1 2:30 p.m.

Jointly with Boiler Feedwater Studies

See Boiler Feedwater Studies II

III TUESDAY, DECEMBER 2 2:30 p.m.

Jointly with Fuels

See Fuels IV

IV TUESDAY, DECEMBER 2 8:00 p.m.

Jointly with Management

The Challenge to American Science and Engineering, by *Allen Kent* and *J. W. Perry,* Western Reserve Univ. (Paper No. 58—A-66)

Engineering Information—All is Not Lost, by *R. H. Phelps,* Engineering Societies Library

The Gross Dimensions of the Technical Information Problem, by *H. V. Kincaid* and *O. W. Whitby,* Stanford Research Inst.

V WEDNESDAY, DECEMBER 3 9:30 a.m.

What Industry Wants From the Electric-Utility Industry, by *P. L. Richardson,* E. I. du Pont de Nemours & Co., Inc.

The Unique Delaware Power and Light-Tidewater Agreement, by *F. P. Hyer,* Delaware Power & Light Co.

Panel Members

W. S. Sims, Philadelphia Electric Co.
R. Boberg, Scott Paper Co.
P. L. Richardson, E. I. du Pont de Nemours & Co., Inc.
J. W. Irvine, Newport News Shipbuilding & Dry Dock Co.

VIa WEDNESDAY, DECEMBER 3 2:30 p.m.

Effect of Steam-Turbine Reheat on Speed-Governor Performance, by *Charles Concordia,* Gen. Elec. Co. (Paper No. 58—A-36)

The Application of Computers to the Small Power Plant,[1] by *E. S. Monroe, Jr.,* E. I. du Pont de Nemours & Co., Inc.

Generalized Steam-Power-Plant Heat Balance for Digital-Computer Application,[1] by *Alexander Zabludowsky*, Stone & Webster Engrg. Corp.

VIb WEDNESDAY, DECEMBER 3 2:30 p.m.

Jointly with Properties of Steam

See Properties of Steam

VII WEDNESDAY, DECEMBER 3 8:00 p.m.

Thermal Performance of the Philo Supercritical Unit,[1] by *A. S. Grimes* and *J. A. Tillinghast*, American Elec. Power Service Corp.

A New Performance Criterion for Steam-Turbine Regenerative Cycles,[1] by *J. K. Salisbury*, consulting engineer, Atherton, Calif.

A Combined Steam-Gas-Turbine Cycle to Use Coal,[1] by *R. W. Foster-Pegg*, ALCO Products Inc.

VIII THURSDAY, DECEMBER 4 9:30 a.m.

Shot Cleaning—Its Development and Use for Cleaning Economizers, Tubular Air Heaters, and Applicable Boiler Sections, by *R. E. Chappell*, Diamond Power Specialty Corp., and *R. D. Meyer* (Paper No. 58—A-104)

A Comparison of Cross and Counterflow Cooling Towers,[1] by *Joseph Lichtenstein*, Burns & Roe, Inc.

Thermal and Economic Considerations in the Application of Hydraulic Couplings for Boiler-Feed-Pump Drives,[1] by *T. J. Whelan*, Stone & Webster Engrg. Corp.

IX THURSDAY, DECEMBER 4 2:30 p.m.

Graphitization Failures in Piping, by *J. B. Nuchols* and *J. R. McGuffey*, Union Carbide Nuclear Co. (Paper No. 58—A-56)

Thermal Distortion of Rotors,[1] by *D. F. Parent* and *D. P. Timo*, Gen. Elec. Co.

Continuous Sodium-Tracer Technique in Steam-Purity Tests,[1] by *H. R. Lawrance* and *R. J. Ziobro*, The Griscom-Russell Co.

X FRIDAY, DECEMBER 5 9:30 a.m.

Jointly with Applied Mechanics

Stresses Near a Circular Opening in a Flat Plate, Reinforced With a Cylindrical Outlet,[1] by *E. O. Waters*, Yale Univ.

Stresses in Contoured Openings of Pressure Vessels, by *D. E. Hardenbergh*, Pennsylvania State Univ.

A Three-Dimensional Photoelastic Study of Stresses Around Reinforced Outlets in Pressure Vessels, by *C. E. Taylor*, *N. C. Lind*, and *J. W. Schweiker*, Univ. of Illinois (Paper No. 58—A-148)

XI FRIDAY, DECEMBER 5 2:30 p.m.

Jointly with Process Industries

See Process Industries IV

POWER TEST CODES SESSION

I TUESDAY, DECEMBER 2 9:30 a.m.

Power Test Codes Thermometer Wells, by *J. W. Murdock*, U. S. Naval Boiler & Turbine Lab.

The Calibration of Thermocouples by Freezing-Point Baths and Empirical Equations,[1] by *R. P. Benedict*, Westinghouse Elec. Corp.

PROCESS INDUSTRIES SESSIONS

I THURSDAY, DECEMBER 4 9:30 a.m.

Influence of Hot and Cold-Storage Loads on the Refrigerated-Space Temperature of a Cooling Complex,[1] by *C. F. Kayan*, Columbia Univ.

Air-Conditioning System for an Electronic-Data-Processing-Machine Room,[1] by *J. R. Bailey*, Whitman, Requardt & Associates, Consulting Engineers

II THURSDAY, DECEMBER 4 2:30 p.m.

Jointly with Fuels

Incinerators and Air Pollution

Wastes Incineration,[1] by *W. S. Elliott*

Heat From Incineration,[1] by *H. G. Meissner*, Combustion Engineering Co.

Air Pollution Resulting From Incineration,[1] by *L. P. Flood*, Dept. of Air Pollution Control

Metals For High-Temperature Application in Incinerator Design.[1] by *E. Schoefer*, Alloy Castine Inst.

Relationship of Incinerator-Refractories Design to Air Pollution,[1] by *R. B. Engdahl* and *J. D. Sullivan*, Battelle Memorial Inst.

III FRIDAY, DECEMBER 5 9:30 a.m.

The Compacting Process—A Method of Particle Agglomeration,[1] by *G. J. Jennick* and *H. D. Vanderlip*, Allis-Chalmers Manufacturing Co.

Atmospheric Gas-Fired Infrared Heater for Processing Application,[1] by *Mark Resek*, consulting engineer, Shaker Heights, Ohio

IV FRIDAY, DECEMBER 5 2:30 p.m.

Jointly with Power

Power-Heat-Balance Considerations in Design and Operation of Industrial Plants,[1] by *J. I. Hudson*, E. I. du Pont de Nemours & Co., Inc.

The Utilization of Waste Heat,[1] by *J. H. Potter*, Stevens Inst. of Tech.

PRODUCTION ENGINEERING SESSIONS

I MONDAY, DECEMBER 1 9:30 a.m.

Jointly with Plastic Flow of Metals, Metals Engineering, Applied Mechanics, and Lubrication

See Plastic Flow of Metals

II TUESDAY, DECEMBER 2 9:30 a.m.

Jointly with Machine Design and Applied Mechanics

Machinability of Metals,[2] by *Hidehiko Takeyama* and *E. Usui*, The Government Mechanical Lab., Tokyo, Japan (Paper No. 58—A-161)

Vibrations of Flexible Precision-Grinding Spindles, by *R. S. Hahn*, The Heald Machine Co. (Paper No. 58—A-97)

Self-Excited Vibrations in Metal Cutting,[1] by *N. Cook*, M.I.T.

The Efficient Use of Welded Steel in Machine Design,[1] by *O. W. Blodgett*, The Lincoln Elec. Co.

III TUESDAY, DECEMBER 2 2:30 p.m.

Jointly with Management

Operations Analysis

The Use of Simulation in Management Analysis—A Survey,[1] by *D. G. Malcolm*, Booz, Allen & Hamilton

Employment Stabilization,[1] by *J. F. Magee*, Arthur D. Little, Inc.

Practical Use of Analysis Techniques in System Simulation,[1] by *A. W. Baldgreff*, The Rand Corp.

IV WEDNESDAY, DECEMBER 3 9:30 a.m.

Jointly with Machine Design

Development and Application of Trepanning,[1] by *A. C. Heidenreich*, The Warner & Swasey Co.

Abrasive Finishing of Hard Gears,[1] by *Harry Pelphrey*, Michigan Tool Co.

The Effects of Recent Industrial Diamond Developments,[1] by *C. I. Fanning*, General Motors Inst.

V WEDNESDAY, DECEMBER 3 2:30 p.m.

Kennametal Dynamometer Utilizes the High YME of Carbide for Rigidity in Construction, by *J. M. Galimberti*, Kennametal, Inc. (Paper No. 58—A-87)

High-Range Plasticity of Metals Beyond Normal Work Hardening, by *E. V. Crane* and *W. S. Wagner*, E. W. Bliss Co. (Paper No. 58—A-132)

The Wear of Abrasives in Grinding,[1] by *G. J. Goepfert*, and *Josephine L. Williams*, The Cincinnati Milling Machine Co. (Paper No. 58—A-157)

VIa THURSDAY, DECEMBER 4 9:30 a.m.

Jointly with Aviation, Machine Design, and Instruments and Regulators

See Aviation VIa

VIb THURSDAY, DECEMBER 4 9:30 a.m.

The Effect of Process Variables on Extrusion Pressures in Lead, by *Joseph Frisch* and *E. G. Thomsen*, Univ. of California (Paper No. 58—A-109)

[1] Paper not available—see box on page 117.
[2] Not presented orally.

Approximate Solutions to a Problem of Press Forging, by *A. S. Kobayashi*, Illinois Inst. of Tech., and *E. G. Thomsen*, Univ. of California (Paper No. 58—A-140)

Theory and Experiment of Press Forging Axisymmetric Parts of Aluminum and Lead, by *A. S. Kobayashi*, Illinois Inst. of Tech., and *R. Herzog*, *J. T. Lapsley, Jr.*, and *E. G. Thomsen*, Univ. of California (Paper No. 58—A-154)

VIc THURSDAY, DECEMBER 4 9:30 a.m.

Jointly with Safety and Machine Design

See Safety II

VIIa THURSDAY, DECEMBER 4 2:30 p.m.

Jointly with Aviation, Machine Design, and Instruments and Regulators

See Aviation VIIb

VIIb THURSDAY, DECEMBER 4 2:30 p.m.

A Three-Dimensional Tool-Life Equation—Machining Economics, by *B. N. Colding*, The Cincinnati Milling Machine Co. (Paper No. 58—A-123)

Some Observations on the Shearing Process in Metal Cutting, by *A. S. Kobayashi*, Illinois Inst. of Tech., and *E. G. Thomsen*, Univ. of California (Paper No. 58—A-139)

Observations on the Angle Relationship in Metal Cutting, by *D. M. Eggleston*, *R. Herzog*, and *E. G. Thomsen*, Univ. of California (Paper No. 58—A-138)

VIIc THURSDAY, DECEMBER 4 2:30 p.m.

Jointly with Safety and Machine Design

See Safety III

PROFESSIONAL PRACTICE COMMITTEE SESSION

I MONDAY, DECEMBER 1 2:30 p.m.

Licensing of Engineers,[1] by *W. H. Larkin*, Air Preheater Corp.

Operational Problems of the Medium-Sized Consulting Engineer's Office,[1] by *J. K. M. Pryke*, Slocum & Fuller

Session will be followed by a social period at which cocktails will be served on a "Dutch Treat" basis.

PROPERTIES OF STEAM SESSION

I WEDNESDAY, DECEMBER 3 2:30 p.m.

Jointly with Power

RAILROAD SESSIONS

I THURSDAY, DECEMBER 4 2:30 p.m.

Progress in Railway Mechanical Engineering 1957–1958,[1] by *D. R. Meier*, Gen. Elec. Co.

Glass Fiber Banding on Traction-Motor Armatures,[1] by *E. C. Appleby*, Westinghouse Elec. Corp.

The Economics of Reclamation of EMD 567 Engine Cylinders With Porous Chrome,[1] by *J. M. A. Van der Horst* and *Russell Ryles*, Van der Horst Corp.

II FRIDAY, DECEMBER 5 9:30 a.m.

Low-Carbon-Intermediate-Manganese Constructional Steel Castings,[1] by *R. D. Engquist*, American Steel Foundries

Use of Radioactive Tracers for Evaluation Ware in Locomotive Diesel Engines,[1] by *P. V. Garin*, Southern Pacific Co.

Diesel Lube Oils, Their Filtration and Effect on Engine Life,[1] by *Ray McBrian* and *L. C. Atchison*, Denver & Rio Grande Western RR Co.

III FRIDAY, DECEMBER 5 2:30 p.m.

Review of the Development of Draft Gears,[1] by *N. T. Olsen*, Peerless Equipment, Div., Poor & Co.

Car-Oil Development,[1] by *R. F. Meeker* and *D. C. McGahey*, The Texas Co.

Train-Resistance Study,[1] by *W. M. Keller*, Association of American Railroads

RUBBER AND PLASTICS SESSIONS

I WEDNESDAY, DECEMBER 3 9:30 a.m.

Epoxy Resins and Their Application as Adhesives,[1] by *D. Richart, S. H. Richardson*, and *C. F. Pitt*, Bakelite Co.

The Strength of Curved-Glued-Laminated Wood Timbers as Affected by Radius of Curvature and Lamination Thickness,[1] by *W. J. Finnorn*, Timber Engineering Co., and *Andrew Rapavi*, Bureau of Ships

Control of Flexural Strength of Glass-Fiber Resin Laminated by Glass-Surface Treatment and Theoretical Implications,[1] by *N. M. Trivisonno*, B. F. Goodrich Research Center

Recent Developments in Reinforcement,[1] by *W. E. Dirkes*, Wright Air Development Center

Prediction of Load and Creep-Deflection in Beams and Eccentrically Loaded Members,[1] by *O. M. Sidebottom* and *Sangiah Dharmarajan*, Univ. of Illinois

Room-Temperature Vulcanizing Silicone Rubber, a Versatile New Engineering Material,[1] by *R. Treat, Jr.*, Gen. Elec. Co.

II WEDNESDAY, DECEMBER 3 2:30 a.m.

Some High-Speed Tensile Properties for Thermoplastics,[1] by *R. E. Ely*, Army Rocket & Guided Missile Agency, Redstone Arsenal

Designing With "Delrin" Acetal Resin,[1] by *W. C. Warriner*, E. I. du Pont de Nemours & Co., Inc.

Applications of Solid Polyurethane,[1] by *K. H. Grim*, Disogrin Industries, Inc.

Review of Developments in Plastics Engineering 1957–1958,[1] by *R. A. Clark* and *R. I. Leininger*, Battelle Memorial Inst.

Polymers Are Not Products in Plastics Fabrication,[1] by *J. E. Tollar*, The Dow Chemical Co.

III THURSDAY, DECEMBER 4 9:30 a.m.

Design of Engineering Properties in Plastics

Molecular, Microscopic, and Macroscopic Structural Data in the Design of Plastics-Molding Compositions to Fit Service Specifications,[1] by *R. M. Evans*, The Master Mechanics Co., and *E. G. Bobalek*, Case Inst. of Tech.

Significance of Physical Test Methods in Interpreting Design Properties of Plastics,[1] by *R. M. Evans*, The Master Mechanics Co., and *S. M. Skinner*, Case Inst. of Tech.

Chemical Degradation and Mechanical Testing of Polyethylenes,[1] by *J. N. Henderson, T. T. Serafini* and *E. G. Bell*, Case Inst. of Tech.

[1] Paper not available—see box on page 117.

The Liaison Problem of the Translation of Laboratory-Design Data Into Production Practice,[1] by *Robert Gelin* and *R. F. Toomey*, Case Inst. of Tech., and *William Ellslager*, The Glidden Co.

Important Design Considerations for Reinforced Plastics,[1] by *Harry Nara*, Case Inst. of Tech.

Summary of Papers Presented at Rubber and Plastics Sessions 1, 2, and 3, by *D. H. Cornell*, Gen. Elec. Co.

SAFETY SESSIONS

I MONDAY, DECEMBER 1 2:30 p.m.

Jointly with Nuclear Engineering

See Nuclear Engineering :I

II THURSDAY, DECEMBER 4 9:30 a.m.

Jointly with Production Engineering and Machine Design

Specification and Selection of Production-Stamping Presses,[1] by *Carl Pearson*, Fisher Body Div.

Human Factors in Machine Design,[1] by *D. B. Learner*, General Motors Corp.

Medicine, Philosophy, and Management,[1] by *D. H. Hogshead*, E. I. du Pont de Nemours & Co., Inc.

III THURSDAY, DECEMBER 4 2:30 p.m.

Jointly with Production Engineering and Machine Design

Press Design for Prime and Producing Accuracy,[1] by *Basil Georgeff*, Danley Machine Specialties, Inc.

How Press Designs Have Improved Safety in Industry,[1] by *Norman Dunlap*, Minister Machine Co.

SOLAR ENERGY SESSION

I FRIDAY, DECEMBER 5 9:30 a.m.

Energy Storage

Electrical Storage of Solar Energy,[1] by *H. L. Foote, R. C. Shair*, and *D. H. Smith*, Bell Telephone Labs.

Selective Surfaces and Absorbers,[1] by *E. A. Farber*, Univ. of Florida

Panel: Selective-Absorptive Surfaces

TEXTILE ENGINEERING SESSIONS

I FRIDAY, DECEMBER 5 9:30 a.m.

II FRIDAY, DECEMBER 5 2:30 p.m.

WOOD INDUSTRIES SESSIONS

I FRIDAY, DECEMBER 5 9:30 a.m.

Recent Design and Progress in the Far Eastern Plywood Plants[1]

European Research and Development in Woodworking Machinery[1]

Recent Developments in Balsa Wood[1]

WOMEN'S PROGRAM

SUNDAY, NOVEMBER 30

2:00 p.m.	Registration
4:00 p.m.	"Early Bird" Party

MONDAY, DECEMBER 1

8:00 a.m.	Registration
9:00 a.m.	Coffee Hour
12:15 p.m.	President's Luncheon
2:00 p.m.	Auxiliary Workshop
8:00 p.m.	Social Get-Together for ASME Men and Women, Entertainment Courtesy of Scandinavian Airlines

TUESDAY, DECEMBER 2

8:00 a.m.	Registration
9:00 a.m.	Coffee Hour
10:00 a.m.	Annual Business Meeting of the Auxiliary
12:00 noon	Sandwiches and Coffee
4:00 p.m.	Tea Dance
7:00 p.m.	Night Club Tour

WEDNESDAY, DECEMBER 3

8:00 a.m.	Registration
8:30 a.m.	National Board Breakfast
8:30 a.m.	General Coffee Hour
9:00 a.m.	Glass Blowing Program
12:00 noon	Annual Luncheon and Fashion Show, Sert Room, Waldorf-Astoria Hotel. Speaker: Mrs. Edward R. Murrow
8:00 p.m.	Theatre Party: "My Fair Lady," or "The Music Man"

THURSDAY, DECEMBER 4

8:00 a.m.	Registration
8:30 a.m.	Coffee Hour
9:00 a.m.	Auxiliary Workshop
12:00 noon	Luncheon and Speaker
7:00 p.m.	Annual Banquet and Reception
10:00 p.m.	Dance

Symposium on Stall in Fluid Flow

The Fluid Mechanics Committee of the Hydraulics Division is planning a Symposium on Stall to be held during the ASME Annual Meeting, Thursday and Friday, December 4 and 5, 9:00 a.m. to 12:15 p.m., and 2:00 p.m. to 5:15 p.m.

Stalling is the fluid phenomenon least understood but of greatest importance to the designer of turbomachinery, ducting, piping, valving, and any other fluid-handling devices. The prediction of stalling behavior is almost always the key to: insight into the gross nature of the flow, analytical models of authenticity, and optimization.

The symposium is constructed of two parts:

First, the consideration of the fundamental aspects of stall prediction and control; second, examples of actual cases wherein a rational approach to stall prediction and control has yielded gains in performance.

All persons intending to attend this symposium should so indicate by writing directly to Robert C. Dean, Jr., Ingersoll-Rand Company, Phillipsburg, N. J., before November 15. A preprint collection of outlines, figures, and references for each part of the Symposium program will be mailed before the meeting to these responders.

1958 ASME Power Show to Feature Improved Heat Control

New techniques in heat control will be featured among the many advanced designs at the 23rd National Exposition of Power and Mechanical Engineering in the New York Coliseum, December 1 to 5. The Exposition will be held under the auspices of The American Society of Mechanical Engineers, and already manufacturers of power and allied equipment have contracted for occupancy of the first and second floors of the display area.

Heat-Exchange Equipment

Heat-exchange equipment has become one of the most fertile fields for invention in recent years. Even before the demands of atomic power plants had drawn attention to the apparent paradox of liquid metal cooling, changing concepts were beginning to influence designers. This year's exposition will feature their latest advances.

Noteworthy have been the applications of the so-called thermal liquids which, unlike steam, are capable of absorbing heat without developing heavy pressures, even at relatively high temperatures. "Pressureless" systems, employing special chemical liquids—and in one instance even eutectic salts—are used in temperature ranges from -100 to $+1000$ F for both heating and cooling applications. As a matter of course, the use of high-temperature nonvaporizing media entails specially engineered heat-exchange equipment in which heat-transfer rates are controlled throughout.

One exhibitor has developed equipment for such exacting applications as plastics and rubber, oils and fats, drugs and pharmaceuticals, paints and varnishes, paper and textiles, metal bonding, metal and ore processing, organic chemicals, and even snow melting.

Instruments and Regulators

The extent to which industrial equipment is being promoted into extreme operating conditions of temperature and pressure is underscored by the incidence of instruments and controls, newly designed or rebuilt, to withstand long ranges between the current extremes of cold and heat, and also to cope with corrosives, explosives, and many toxic substances.

Many exhibits will reflect this trend, also showing wide departures from conventional thinking. A newly designed high-pressure steam gage, new explosion-proof illuminators, and jet pumps for fueling and defueling missiles will be incorporated in one display.

Plastic solenoid valves for handling corrosive liquids will be another innovation.

A number of displays will reflect the latest designs for level gages and specialized instrument valving. There will be a boiler water-level indicator which completely avoids the use of glass. Replacing the conventional water column is an indicator of like appearance in which the water-steam line is shown by a simulated water level that is positioned magnetically. Another exhibitor has developed a miniature water-level indicator, as well as a pressure differential unit for remote indication.

Machinery Speed-Up Advances

Another field in which progress has entailed new manufacturing problems and produced additional equipment is the almost universal speed-up of machinery. High speeds produce destructive vibration unless counteracted by improved design and perfected by better balance. In consonance with this trend a research organization has come forth with a vibration analyzer which permits revolving parts to be dynamically balanced without being dismantled. In one form, the analyzer acts as an electronic "brain," effecting, it is said, a 50-percent reduction in the cost of the balancing machine.

Power-Line Failure Control

Uninterrupted power supply is of increasing importance as humanity becomes more highly dependent on electricity. In public auditoriums and other uses it is often required by law, while many industrial operations would be heavily damaged were not emergency current available in the event of power line failure. Several exhibits will offer solutions for this problem.

One line of automatic transfer switching equipment cuts in an emergency power circuit when the main source fails, its distinguishing feature being a mechanical holdout. This type of lockout avoids the "a-c hum" of switches that are held on line electrically.

Another innovation in emergency power supply equipment is a sealed unit consisting of a nickel cadmium battery with automatic charger and the necessary controls. This entirely self-sustaining package unit is especially designed for switchgear operation, relays, emergency lighting, and other standby services.

Often, new equipment enlarges the engineering vocabulary, as in the "couple switch." This combines a differential expansion temperature switch with a thermocouple—two functions fulfilled by one simple, inexpensive unit.

Instrumentation for the power plant continues to provide more precise information, more readably presented and with improved safeguards against man failure. In one group of instruments for the powerhouse a new force-balance signal transmitter will be offered in ranges from 50 to 5000-lb operating pressures. A multipointer gage will provide twice the indications in less space than the conventional gage.

Many displays will present effective solutions for operational problems common to most plants. There will be high and low-pressure oil burners, parts and accessories, solvents that are said to convert sludge into combustible material, as well as soot-burning chemicals.

Something New Has Been Added

Air and electric torque-control equipment have been added to a line of boiler and condenser tube expanders specially designed to work on closely spaced tubes in thin sheets.

A complete line of preventive maintenance-testing equipment includes a new 5-kv dielectric test set, a new 6-voltage rectifier operated insulation tester, and a new precision tachometer.

An excess-flow check snubber contributes to plant safety by preventing the escape of noxious, toxic, or flammable liquids or gases.

A line of "quick connects" includes plastic and metal O-seal fittings which form rapid leakproof connections against flat surfaces. A metal fitting with interchangeable ferrules seals glass tube connections.

A welding specialist will offer an advanced low-amperage electrode that permits crack and porosity-free welding of dirt and oil-saturated cast iron; another for welding medium to high alloy steel, affording strengths up to 120,000 psi.

The principal focus of the Exposition will be on the production and distribution of power in industrial establishments of every description. Many of the exhibits concern the generation and distribution of energy in heat, electricity, gases, compressed air, and liquids, as well as motion. Examples of functional machinery and processing equipment will also be on view.

This comprehensive array will be of interest to scientists and engineers, drawing visitors from the entire continent and many countries overseas. Admission will be by invitation and registration only, exclusive of the general public.

Heat-Transfer Divisions in Joint Conference

Men of the ASME and AIChE
who engineer the transmission of heat
present latest in research and practice

THE EDGEWATER BEACH HOTEL

Sooner or later, research pays off. This was apparent, again, as engineers attending the second national Heat-Transfer Conference added their technical papers to the growing literature. The year's writings revealed practical development of investigations which were in the pure-science stage 12 months ago. (For the story of the first conference, see Mechanical Engineering, October, 1957, pp. 996–1000.—Editor.)

Mecca for Heat-Transfer Engineers

On banquet night, a speaker remarked that heat-transfer engineers were even more loyal to their science than to their companies. He added that this was a good thing for the companies. This loyalty to a subtle and exacting technology drew 527 engineers to the second annual Heat-Transfer Conference and Exhibit, Chicago, Ill., Aug. 17–20, 1958, held jointly by the American Institute of Chemical Engineers and The American Society of Mechanical Engineers. Meetings were held in the Edgewater Beach Hotel on Chicago's swank North Shore, "18 minutes from the loop," just below Northwestern University's campus at Evanston. The conference was sponsored by the heat-transfer divisions of both societies.

The ASME and the AIChE, between them, have most of the country's heat-transfer engineers. At the banquet, main speaker Thomas H. Chilton, Mem. ASME, and Technical Adviser to the Du Pont Engineering Department, spoke of "this happy example of intersociety co-operation." Roland S. Stover, Vice-President of the ASME's Region VI, made a plea for unification of the profession in the manner of this joint heat-transfer conference, an objective seconded by Donald L. Katz, Vice-President of the AIChE. The development of joint conferences has long been an ASME goal, recognized as an important step in the dissemination of technical information.

The men who met in Chicago to present and discuss technical papers represented more than 200 firms, a cross section of the country's industrial plant. The conference records show aircraft firms, oil firms, electric and electronic manufacturers. Of course there were boiler manufacturers and chemical firms. There were glass companies. Names ranged from Caterpillar Tractor to Atomic International, from Lockheed Missile Systems to Babcock & Wilcox, from General Foods to the Bureau of Mines. The burgeoning problems of heat transfer turn up wherever engineering is practiced.

Coming to a Boil

Technically, the meeting was notable for its further exploration of the mechanism of boiling heat transfer. Where last year we saw a breakthrough in the understanding and calculation of these phenomena, the investigations have now advanced toward practical solutions—for boilers, and for any evaporative type of operation. In such fields as nuclear power, the calculation of boiling heat transfer will mean more precise selection of equipment, more precise control of processes.

An AIChE paper from Oak Ridge, entitled "A Preliminary Study of Boiling Burnout Heat Fluxes for Water in Vortex Flow," discussed a higher rate of heat flow than ever before measured.

(*Note:* It was said that a Russian book has been found—published in 1954—which, when translated, may be of great value in this field. It also is rumored that one of the papers being prepared for the ASME Annual Meeting in New York, N. Y., Nov. 30–Dec. 5, 1958, may represent a new breakthrough.)

The conference also had solid papers from industrial sources—plant data for immediate practical application. Papers of this type were well received and aroused spirited discussion. The Exhibit, displaying heat-transfer equip-

1 **Registration mounts early in Chicago as 527 engineers gather at the Edgewater Beach Hotel to attend the second annual ASME-AIChE Heat Transfer Conference. Advances revealed that what was pure science 12 months ago, in many instances, is now in use.**

2 **At the first technical session A. C. Mueller, Mem. ASME, chairman of the AIChE Executive Committee of the Heat Transfer Division made a speech to welcome the vast audience shown assembled in the Main Ballroom of the Edgewater Beach Hotel**

3 **At the banquet head table are, *left to right,* George Bailie, Visking Company, chairman of the AIChE Chicago Section, who welcomed the conference to Chicago; Sigmund Kopp, member of ASME Heat Transfer Division; and Alan Foust, member of the AIChE Executive Committee**

4 **Another view of the head table shows, *left* to *right,* R. S. Stover, vice-president, ASME Region VI; D. L. Katz of AIChE's Executive Committee on Heat Transfer; and S. P. Kezios, chairman, Executive Committee, ASME Heat Transfer Division**

ment, made a meeting ground for conferees and manufacturers' representatives to discuss new developments—in installation, operation, and maintenance.

A most unusual technical paper, published in the September, 1958, issue of MECHANICAL ENGINEERING, pp. 60–63, was the lesson in technical Russian writing offered by Mrs. F. F. Buckland, Mem. ASME, of the General Electric Company at Schenectady. Probably never has such a large audience followed their preprint copies so avidly during a presentation. The strange Russian alphabet is primarily Greek and English characters, but with unfamiliar pronunciations. It is startling to discover that a Russian word, which looks like something carved on an Egyptian tomb, becomes a familiar English word when one knows how to pronounce the symbols.

Dots Across the Sky

Missile engineers in need of inspiration could repair to the hotel's roof, of an evening, and find a Ground Observer Corps station busy recording the passage of Russian hardware overhead. The rocket of Russia's third satellite, making its tumbling circuit of the earth in a little more than an hour, happened to be visible, traversing its arc from horizon to horizon. Its altitude: 670 miles. Because it was tumbling, it reflected the sun's light intermittently, a series of dots across the night sky. Memorable remark by R. J. Faxon, Team Leader of the moon-watch station: "There. It's just about over Texas now."

Close up, there were field trips, three of them, to the Argonne National Laboratory, to Armour Research Foundation, and a trip in which visits to Cook Research Laboratories and Northwestern Technological Institute were combined. Visitors to the Argonne Lab saw an experimental boiling-water reactor, a liquid-metals experimental facility, and experiments in the preservation of food by irradiation. Steaks and chops had been placed in polyethylene bags and irradiated by gamma rays from fission products in spent fuel elements. Samples irradiated a year ago were unharmed by the passage of time, suggesting that here is a method of food storage of immense value to the world. (To the question of how the meat tasted, answers were evasive and/or unsuitable for publication.)

Have you attended an anecdote session at a technical conference? It has possibilities. On Monday, the conference held a luncheon at which each table (eight men) was asked to scrounge up an anecdote of heat-transfer engineering. One man from each table was appointed spokesman to report his table's contribution. Sample: The group who installed a $30,000 pump to speed up heat transfer—and the rate declined. Pay-off: The pump proved to be just what the plant needed to flush slurry.

This half hour of engineering pleasantry took place in the hotel's Polynesian Room, with its Sumatran huts, pillars from a Balinese temple, shields from Tanganyika. The sandwiches were authentic Chicago.

Banquet Night

A conference banquet has a way of bringing the meeting into focus. At this banquet, engagingly toastmastered by Myron Tribus, Mem. ASME, of UCLA, a basic point became clear: This conference, like its predecessor at

1


2


3


4

Heat-Transfer Conference

Main speaker at the banquet. T. H. Chilton, Mem. ASME, technical adviser to Du Pont Engineering Department, develops the theme that heat-transfer engineering inevitably called for co-operation between the great engineering societies.

G. M. Dusinberre of Penn State and Mrs. F. F. Buckland of GE at a Monday afternoon session. Mrs. Buckland presented a paper on Russian vocabulary to enable heat-transfer engineers to read Russian technical papers.

Penn State, achieved its greatest significance because of its co-operative character, its joint sponsorship by two leading engineering societies. Mr. Chilton, the main speaker, brought out the fact that heat transfer has always cut across professional lines, making intersociety co-operation imperative.

"As early as 1912 . . . that renowned electrical engineer Irving Langmuir, Nobel Prize winner in physics . . . (presented a paper) . . . on heat transfer rates from fine wire to gases."

At about the same time, Mr. Chilton related, the *Journal of Industrial and Engineering Chemistry* discussed a paper on analysis of heat transfer in terms of film and over-all coefficients by H. P. Gurney, later of the Gurney-Lurie charts. And, of course, the ASME had "a concern with boilers and condensers from the beginning," 78 years ago.

In 1932, the ASME's Process Industries Committee "held, in June of that year, in Buffalo, a session on heat transfer." That same year, "there appeared in MECHANICAL ENGINEERING the immensely valuable series of papers by W. J. King entitled 'The Basic Laws and Data of Heat Transmission.'"

Looking to the future, Mr. Chilton saw a further merging of efforts in intersociety co-operation on heat transfer. For 1961, it is planned that "three more societies will join in sponsorship: The Chemical Institute of Canada, the American Nuclear Society, and the American Rocket Society (affiliate of the ASME). Maybe by that time they should bring in the Astronautical Society."

Mr. Chilton enphasized two points: First, that engineering sciences, such as heat transfer, are being recognized as essential in engineering education, but are not "taken care of by specialized curriculums." Second, that "there are matters of concern to the engineering profession outside the realm of science or technology . . . educational standards, licensing and registration, codes of professional ethics, recognition, status, provision for most effective use in service to the nation in peace and war."

The Essential Fact

"I hope you have seen through the network of society organization, committees, and divisions, to the essential fact that individuals with a common interest have found ways of working together toward common aims . . . not letting organizational barriers stand in their way."

AVAILABILITY LIST: HEAT-TRANSFER CONFERENCE PAPERS

THE papers in this list are available in separate copy form until June 1, 1959. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 25 cents each to members; 50 cents to nonmembers.

Paper No. Title and Author

58—HT-1 The Design of Heating Coils for Storage Tanks, by DAVID STUHLBARG

58—HT-2 The Pressure Drop of Condensing Steam in Horizontal Pipes, by R. J. DUNN and DAVID STUHLBARG

58—HT-3 Transient Heat Transfer for Laminar Forced Convection in the Thermal Entrance Region of Flat Ducts, by R. SIEGEL and E. M. SPARROW

58—HT-4 The Heat Exchanger—An Economic Study, by G. T. ATKINS and N. O. FELPS

58—HT-5 Calculation of Transients in a Crossflow Heat Exchanger, by G. M. DUSINBERRE

58—HT-6 Free Convection, Forced Convection, and Acoustic Vibrations in a Constant-Temperature Verticle Tube, by T. W. JACKSON, W. B. HARRISON, and W. C. BOTELER

58—HT-7 A Note on Latent Heat in Digital Computer Calculations, by G. M. DUSINBERRE

58—HT-8 Generalized Correlation of Boiling Heat Transfer, by S. LEVY

58—HT-9 How to Read Heat Transfer in Russian, by MRS. F. F. BUCKLAND

58—HT-10 Transient-Heat Conduction in Elliptical Plates and Cylinders, by E. T. KIRKPATRICK and W. F. STOKEY

58—HT-11 Heat Transfer to a Boiling Liquid; Mechanism and Correlations, by K. E. FORSTER and R. GREIF

58—HT-12 Engineering Method for Determining a Design Envelope for Air-to-Air Crossflow Heat Exchangers, by W. T. SHATZER

58—HT-13 Prediction of Vacuum Tube Bulb Temperatures, by MYRON GOLDBERG

58—HT-14 The Use of Steady-State Electrical Network Analysis in Solving Heat-Flow Problems, by A. D. KRAUS

58—HT-15 The Effectiveness of a Transistor Cap as a Heat Dissipator, by A. D. KRAUS

58—HT-16 Numerical and Machine Solutions of Transient Heat-Conduction Problems Involving Melting or Freezing, Part 1—Method of Analysis and Sample Solutions, by W. D. MURRAY and FRED LANDIS

58—HT-17 Experimental Forced Convection Heat Transfer With Adiabatic Walls and Internal-Heat Generation in a Liquid Metal, by G. L. MULLER

58—HT-18 Emissivity Measurement of Industrial Surfaces Due to Thermal Radiation, by M. N. AREF

58—HT-19 Void Volumes in Subcooled Boiling Systems by P. GRIFFITH, J. A. CLARK, and W. M. ROHSENOW

58—HT-20 Two-Phase Pressure Drop for Horizontal Crossflow Through Tube Banks, by J. E. DIEHL and C. H. UNRUH

58—HT-21 Natural Convection Heat Transfer in Liquids Confined by Two Horizontal Plates and Heated From Below, by SAMUEL GLOBE and DAVID DROPKIN

How the Petroleum Meetings of ASME Get That Way

1957 Petroleum Meeting registration plan set the pace for the 1958 Petroleum Meeting Program

The Petroleum Conferences of The American Society of Mechanical Engineers have enjoyed a national popularity as symbolized by ever-growing attendance year in and year out. The why of it was revealed in a report recently released by the Petroleum Division.

At the 1957 Petroleum Meeting in Tulsa, the registrants were asked to register and answer a few simple questions. At each session, registration for that event was recorded and thereby hangs the story.

The Punch-Card System

The punch-card system was tried for the purpose of providing the operating committee chairmen with better information for their program-planning work. The three basic objectives were as follows:

1 To provide a profile of the registrants at the conference by their petroleum-industry division of interest, by the type of organization with which they are associated, and by the type of position they held in that organization.

This was accomplished by having each registrant fill in the card shown in Exhibit 1 at Registration. A prepunched registration number was given to the card and placed on the registrant's name tag.

2 To provide a profile of the audience in attendance at each session.

This was accomplished by having each member of the audience at a session enter his registration number on the card shown in Exhibit 2. This was passed out in lieu of the normal ASME session attendance card and it had the session information prepunched.

3 To provide an objective qualitative analysis of each paper presented at the conference.

This is accomplished by passing out the card shown in Exhibit 3 to those in attendance at the conclusion of the presentation of each technical paper. This card had the session and paper information prepunched. Note that the registrant was not asked to identify himself by name or number. This was considered necessary to remove any bias in the comments. Questions regarding the paper were carefully worded in accordance with opinion survey techniques to give a really good picture of the reaction of each individual to the presentation.

1.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
PETROLEUM MECHANICAL CONFERENCE—1957

________ is your Registration Number. Would you please give your interest
Col. 2-3-4
classification by checking one space in each of the three columns below:

Check One	Check One	Check One
I am associated with the following Industry Division:	I am associated with the following type of Organization:	My position is:
Col. 5	Col. 6	Col. 7
1 ☐ Refining	1 ☐ Oil or Gas Company	1 ☐ Executive-Administrative
2 ☐ Drilling-Production	2 ☐ Equipment Manufacture	2 ☐ Engineering
3 ☐ Pipeline	3 ☐ Engineer-Constructor	3 ☐ Service-Application
4 ☐ Several Divisions	4 ☐ Service Organization	4 ☐ Operation-Supervision
	5 ☐ Consultant	5 ☐ Other
	6 ☐ Drilling Contractor	
	7 ☐ Other	

This information will be analyzed on the McEvoy Company's UNIVAC computer, through courtesy of Mr. Allen Rhodes. The analytical results will be of assistance in planning future conferences to better serve the interests of attendees and the Industry.

2.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
PETROLEUM MECHANICAL CONFERENCE—1957

Please note your Registration Number on this card in the space below. This will be used only for internal analysis of session attendance patterns by attendee interest, as indicated on your registration questionnaire:

________ Your Registration Number
Col. 2-3-4

3.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
PETROLEUM MECHANICAL CONFERENCE—1957

Your answers to the following questions, about your reaction to this session and the paper, will be sincerely appreciated. This reply is not identified with you in any way, so please be candid in your responses. The results of this survey will lead to better conferences, since the operating committees will be fully informed on your needs and interests.

1. Does the paper give you new technical information?	10 ☐ Much 11 ☐ Some 12 ☐ Little	4. Will the information be of use to technical men in the Industry?	19 ☐ Much 20 ☐ Some 21 ☐ Little
2. Do you easily follow the information presented?	13 ☐ Yes 14 ☐ Some 15 ☐ No	5. Was the discussion sufficient to cover points in question?	22 ☐ Well 23 ☐ Partially 24 ☐ Little
3. Is the subject covered of broad interest to technical men in the Industry?	16 ☐ Broad 17 ☐ Some 18 ☐ Narrow	6. Would you recommend more coverage of this subject at future conferences?	25 ☐ Yes 26 ☐ Perhaps 27 ☐ No

7. Write in any suggestion you have for future conference paper subjects.

28 ☐ ________

Exhibit 4 shows the composition of registrants attending the conference. The oil industry broadly is composed of three functionally separate and distinct divisions; namely, refining, drilling and production, and pipeline.

The industry divisions even within major integrated oil companies operate as separate and distinct affairs with virtually no interchange of people, problems, or techniques. Each simply has an entirely different set of problems. Therefore, it is evident why it is most critical in planning the conference program to know clearly what representation from which divisions can be expected to attend

and what their particular association is. Further, it was evident that there are primarily executive, administrative, and engineering people equally represented from drilling production, with a lesser group from the pipeline division. The greatest number of these persons are either with operating companies or specialized equipment-manufacturing concerns serving the representative industry divisions. This breakdown gives the Petroleum General Committee and the Service Operating Committee precisely the planning information required to properly gear a program to the expected attendance.

Who Attends the Meeting?

The studies were carried to the further depth to examine the kind of people who attended each individual session so that individual operating committees can evaluate the relationship of session subjects to the audience who will be drawn to the sessions. Possibly the most important data are contained in the tabulation of attendees' reactions to the individual papers presented. These data were obtained by asking each individual to answer six general questions.

The entire conference received a strong affirmative reception and is conclusive evidence of the sound and effective program planning which was done for this conference. A significant point was strongly affirmed; namely, that more panel discussions on the pressure vessel code and the piping code were almost unanimously desired. This highest interest in code panel discussions has provided the basis for more presentations of this kind for the 1958 Denver Conference.

The Division's use of this information has been essentially to provide operating committee members with a copy of these data so that each individual may form his own conclusions and apply his specific impressions in his areas of interest and responsibility to his current program planning and paper review; or, in other words, the information is a working tool for the individual operating committee members who actually put together the programs and evaluate papers proposed for presentation.

This procedure was followed at the Denver Conference in exactly the same fashion, to assemble additional comparable data for future guidance.

Exhibit 4

PETROLEUM MECHANICAL CONFERENCE

TULSA, OKLAHOMA - 1957

COMPOSITION OF REGISTRATION

Industry Division	Total	Oil and Gas. Co.					Equipment Manufacturer					Engineer-Constructor					Service Organization					Consultant					Drilling Contractor					Other				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Refining	187	11	80	-	7	2	10	11	5	-	3	11	19	-	-	2	-	3	-	-	-	1	3	-	-	-	-	-	-	-	-	1	15	2	-	1
Drilling-Production	281	5	64	-	5	2	31	53	8	1	6	1	1	-	-	1	1	2	1	-	0	1	2	-	-	-	2	2	-	1	-	3	5	2	-	1
Pipeline	93	4	42	-	8	-	8	10	3	0	3	2	2	-	-	-	2	1	-	1	0	-	-	-	-	-	-	-	-	-	-	2	5	-	-	-
Other	112	1	18	1	1	1	14	30	10	-	3	1	3	-	-	1	-	2	1	-	-	-	3	-	-	-	-	-	-	-	-	2	8	2	1	9
Total	595																																			
	73 Miscoded																																			
Grand Total	666																																			

Position Code:
1 - Executive - Administrative 2 - Engineering 3 - Service - Application 4 - Operation - Supervision 5 - Other

Conducted for the National Junior Committee

JUNIOR FORUM

N. J. VIEHMANN[1]

A Career in Technical Writing

By Albert S. Goldstein[2]

Introduction. A subject about which many engineers know little is the field of technical writing which can offer a challenging and interesting career to the young engineer. The proper presentation of engineering results, in the form of a report, manual, or other type of publication, requires both engineering and technical writing talent. These two skills, engineering and writing, are necessary in technical writing but are rarely found in a single individual. Most companies realize that it is better to train an engineer to be a technical writer, than to teach engineering concepts to a writer. Therefore many young engineers are being encouraged and attracted to a career as a technical writer.

Technical Writing. A career in technical writing requires the ability to comprehend the basic concepts of various engineering and scientific subjects and to present them in an effective manner. A technical writing group, sometimes called a publication group, consists of technical writers, technical editors, technical illustrators, and production personnel (photographers, typists, printers, and clerks). The editors and illustrators are related to the technical writer in a manner similar to the relationship of engineering aides and draftsmen to engineers. Just as the engineer must be able to comprehend various stages of the development of a product, so must the technical writer have a working knowledge of the functions and responsibilities of the people involved in the production of technical publications.

[1] Product Planning Engineer, Western Electric Company, North Andover, Mass. Assoc. Mem. ASME.
[2] Engineering writer, Ithaca, N. Y. Assoc. Mem. ASME.

The mechanics of processing a manuscript is something that a young engineer can learn easily but the writing of technical material requires experience and training. If an engineer has a flair for writing and has been properly trained to write effectively, he will encounter little difficulty in technical writing. Many engineers can be taught to write effectively even though they feel that writing is a chore for which they have little taste.

The technical writer will usually have two major functions. These are: (1) The writing of technical material and the co-ordinating of the writing efforts of a group or groups of engineers; and (2) the co-ordinating of the efforts of all those in the publication group. Therefore the technical writer must be able to work effectively with and organize the efforts of groups of people as well as contribute written material.

The technical writer in most organizations will be required to undertake a variety of writing tasks. He may be asked to prepare many types of instruction manuals which cover theory, operation, maintenance, and overhaul of components or entire systems. He will help prepare progress reports, final engineering reports, and other reports concerning both research and production items. Proposals or engineering bids are another type of publication which require a highly efficient and effective writing performance.

When a writing task is assigned to a technical writer, he will also be given a budget and a due date. It is his function to produce the required results within the allotted time and budget. Therefore, he must establish schedules for the engineering group and the publication group so that material is produced on time and processed efficiently. This requires a large amount of co-ordination and planning, most of which is the responsibility of the technical writer.

Problems. Unfortunately this dual function of co-ordinating and writing has led to much confusion about the role of the technical writer in an engineering organization. In the past the field of technical writing was dominated by persons who did not have a proper engineering background. Because of their lack of technical training, these people concentrated on the co-ordinating function of technical writing and neglected the technical-writing portion of their position. Therefore, when all they did was to correct the grammar and spelling of engineering manuscripts and then process them, they performed the task of a technical editor. This caused and still causes a great deal of difficulty, because a technical writer will find in many instances that he is being asked to perform the functions of an editor. This is especially true in large publication organizations which tend to have too many writers and too few editors.

In a small publication facility there is usually more opportunity for rewarding and challenging work. A good rule of thumb when considering a technical-writing job is to note the ratio of editors to writers. If there are one or more editors for every two writers then chances are greater that the work assigned to the writer will be in line with his capabilities.

Training and Experience. The old adage that engineers cannot write is false because writing ability, like engineering ability, is something that must be developed by proper training and hard work. Most companies now recognize that technical writers should be engineers first and writers second. Therefore they are willing to train young engineers as technical writers and offer salaries equivalent to other engineering salaries. The aircraft and electronics industries employ most of the technical writers so that engineering experience in these fields will be useful to a writer.

Since writing tasks are varied in subject matter and complexity it is easy to introduce technical writing to young engineers by on-the-job training. Small tasks which a good technical editor can undertake are given to the technical-writing novice just as new engineers are usually assigned work which good technicians can undertake. In a short while small technical-writing jobs can be assigned which present more of a challenge to the young writer. If placed under the wing of a seasoned technical writer, a young engineer can probably assume almost any technical writing assignment within a year. Of course, several years of experience are required to learn the many facets of the job and how to deal effectively with both engineering and publication groups.

Conclusions. The advantages of technical writing are that assignments are short and may cover a variety of projects. This enables the technical writer to see the fruits of his labor; something that many engineers do not see for many years. He will not become an expert or specialist in any one narrow field of engineering, but he will be a highly skilled specialist in the field of technical writing. He will also be an engineer with a good knowledge of many technical subjects.

The future is promising for technical writers for as equipment grows in complexity the need for better communication through written matter will grow. There will be a large choice of jobs at good salaries, and technical writers because of their training and experience are quite suited for administrative positions which require engineering co-ordinating and planning ability.

Technical societies for technical writers and editors now exist on a national basis and the AIEE-IRE has a group (PGEW) devoted to fostering the interests of those in the technical-writing field. Many papers on technical writing are now presented at technical society meetings and technical writing conventions are held in many areas. Technical writing is now a field which holds much promise for the young engineer.

Chairman's Corner

"Member, ASME"

PROFESSIONAL registration has been emphasized in the Junior Forum during the past year. It has been thoroughly discussed in more than one of the articles and a complete list of mailing addresses of the 48 State Boards has been printed.

Another form of recognition for the engineer who has achieved the status of a professional is his admission into ASME as a full member. The qualifications for admission are outlined briefly below.

A candidate shall be a graduate of an engineering curriculum approved by the Council, and in addition shall have had six years active practice in the profession of engineering or teaching, five years of which shall have been in a position of responsible charge of engineering work. He shall be qualified to direct such work or to carry on important research or design in the field of engineering. A nongraduate shall have had at least 12 years active practice, five of which shall have been in responsible charge of engineering work.

A detailed description can be found in the Application for Membership which is available from Society Headquarters.

The recent graduate can benefit from a study of these requirements. What better goals than these could he set for himself as he embarks on his engineering career.

—*Norman J. Viehmann*

Twelve Regional Conferences Held for ASME Student Members in 1958

Conferences feature prize-winning papers, inspection trips, and social events—to give conferees an idea of regular Society event

More than 1700 Student Members of The American Society of Mechanical Engineers and their faculty advisers met at 12 Regional Conferences throughout the country in the spring of 1958. More than 100 engineering colleges were represented and 138 high quality papers were presented.

One of the major values of the Regional Conference is that it affords the opportunity for the student to glimpse certain operational aspects of the Society's Annual Meeting. The contributions which that meeting makes to the general membership are sampled from a program which is a reproduction in miniature of the Annual Meeting.

These conferences have been designed to promote professional development by bringing together student engineers from neighboring schools to compete in presentation of technical papers; to discuss problems of student-section administration; plan for the coming academic year; listen to leaders in industry, educators, and engineers discuss matters of import to engineers; and generally to enjoy a social program, luncheons, dinner, and various plant inspection trips.

Over the years, the consensus has been that the greatest benefits derive from the acquaintances made, the closer relation of the students to the Society, and excellent quality of the student papers.

Prizes are awarded to the students delivering the best papers; to the school with the largest attendance, other than the host school; enrollment of the largest percentage of potential members; and the greatest number of man-miles traveled.

Across the Country

Across the country two items that came up were the Industrial Indoctrination Seminars and the ASME Student Program.

The Industrial Indoctrination Seminars, such as were conducted jointly by Lehigh and Lafayette, and earlier by Newark, are catching on. These were considered excellent, particularly so, as they answered many questions of concern to students. In addition, there was good audience participation.

The Student chairmen were asked to carry back to their sections the fact that the entire ASME Student Program is developed in such a manner that an individual is automatically promoted from a Student Member to an Associate Member after having completed the requirements for his engineering degree. Further, the request was made that each student fill out the white cards sent during May to their school requesting a change of address and indicating the three professional divisions in which they evince a special interest. It was pointed out this is no more difficult to do than changing one's address for a magazine subscription, yet at the moment there are some 1400 former students whose whereabouts are unknown and consequently the Society cannot service them.

Another meeting brought forth this comment: "The conference went smoothly enough except for the inevitable confusion and distress which attends the use of slides by the inexperienced. Ability to present an organized analysis is often obscured by darkness, unmanageable slides, and flashing light."

1958 ASME Regional Student Conference Winners

REGION I, NEW ENGLAND, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, CAMBRIDGE, MASS., APRIL 11–12, 1958

Attendance: 180 — Papers Presented: 14

Prize	*Recipient*	*Title of Paper*	*College*
First	Richard S. Taylor, Jr.	A Mechanical Device for Obtaining Hyperbolic Functions of Variable Quantities	University of Massachusetts
Second	Basil G. Constantine	Instantaneous Pressure Measurement in Firearms	Worcester Polytechnic Institute
Third	Clement R. Confessore	Development of an Automatic Airbrake-Hose Coupler	Norwich University
Fourth	Robert B. Brown	Some Aspects of Modern Management Techniques	University of Vermont
Old Guard	Robert S. Woolman	Plasma, Rocket Propellant of the Future	Dartmouth College

REGION II, EASTERN, NEW YORK UNIVERSITY, NEW YORK, N. Y., APRIL 26, 1958

Attendance: 36 — Papers Presented: 5

Prize	*Recipient*	*Title of Paper*	*College*
First	Mrs. Janet S. O'Brien	The Variables Affecting Natural Circulation in Large Boilers	New York University—Evening Division
Second	Stanley Small	Problems on Engineering Education	City College of New York
Third	George N. Freund	Automotive Ignition and Oscillography	Newark College of Engineering
Fourth	Richard Emmons	Power Steering as a Servomechanism	Rutgers University

REGION III, ALLEGHENIES, CORNELL UNIVERSITY, ITHACA, N. Y., APRIL 18–19, 1958

Attendance: 141 — Papers Presented: 16

Prize	*Recipient*	*Title of Paper*	*College*
First	Joseph F. Panas	An Engineering Approach to a Psychophysiological Problem	Villanova University
Second	James R. Houghton	Solar Energy Collectors	George Washington University
Third	Douglas A. Cobb	Patents and Engineers	Princeton University

Fourth	Robert S. Hartman	Varying Boiler Loads—Some Effects and Remedies	Lehigh University
Old Guard	Franklin L. Woods	Some Effects of Supersonic Flight on Aircraft Metals	Howard University

REGION IV, SOUTHERN, VANDERBILT UNIVERSITY, NASHVILLE, TENN., APRIL 10–12, 1958

Attendance: 183 Papers Presented: 10

Prize	*Recipient*	*Title of Paper*	*College*
First	Charles E. Feltner	Development of a Fatigue-Testing Machine for Axial Loads Applied By Resonant Vibrations	North Carolina State College
Second	Edward L. Prichard	Space Travel	University of Florida
Third	Wilson C. Urrutia	The Nuclear Propulsion of Ships	Virginia Polytechnic Institute
Fourth	Thomas Robins	A Thermal Analyzer	Duke University
Old Guard	William C. Tuggle	Control of Mix-Ball Size in Fabrication of Carbon Electrodes	Vanderbilt University

REGION V, MIDWEST, UNIVERSITY OF DETROIT, DETROIT, MICH., APRIL 10–11, 1958

Attendance: 183 Papers Presented: 11

Prize	*Recipient*	*Title of Paper*	*College*
First	Thomas H. Larsen	Engineering Speaking Teams	Ohio State University
Second	Charles Fritsch	Rocket Fuel	University of Dayton
Third	Edward C. Warfel	Energy From Outer Space	University of Pittsburgh
Fourth	Frank J. Loss	Solar Energy	Carnegie Institute of Technology
Old Guard	Richard T. Driftmeyer	An Argument for Graduate Study	University of Toledo

REGION VI, NORTHERN TIER, MARQUETTE UNIVERSITY, MILWAUKEE, WIS., APRIL 18–19, 1958

Attendance: 147 Papers Presented: 9

Prize	*Recipient*	*Title of Paper*	*College*
First	Ronald J. Baschiere	Heat Transfer From a Cone by the Transient Method	Illinois Institute of Technology
Second	Mason Myers	Application of Solar Furnace Design	University of Minnesota
Third	Carl J. Wymelenberg	Progress in Metal Cutting	Marquette University
Fourth	Rhoderick J. McPeak	Prediction of Peak Loads in Power Systems	Iowa State College
Old Guard	Curtis G. Moen	Operating Ethics of the Professional Engineer	University of North Dakota

REGION VI, SOUTHERN TIER, UNIVERSITY OF NOTRE DAME, NOTRE DAME, IND., MAY 2–3, 1958

Attendance: 124 Papers Presented: 13

Prize	*Recipient*	*Title of Paper*	*College*
First	Herbert G. Siewert	Consideration of Frost in Refrigeration Design	University of Illinois
Second	Jack C. Sammons	Theoretical Turbojet Thrust Augmentation	University of Kentucky
Third	Clifford A. Poots	Design and Fabrication of a Motor Cooling Fan	State University of Iowa
Fourth	Richard Thomas	Potting Short Pot Life	University of Notre Dame
Old Guard	James N. Brentz	The Erection of the World's Largest Power Shovel	Bradley University

REGION VII, PACIFIC NORTHWEST, UNIVERSITY OF BRITISH COLUMBIA, VANCOUVER, B.C., CANADA, MAY 2–3, 1958

Attendance: 140 Papers Presented: 10

Prize	*Recipient*	*Title of Paper*	*College*
First	Michael E. Maes	The Liquid-Fueled Rocket Test Stand at the University of Washington	University of Washington
Second	James D. Watson	Recent Developments in Rocket Propulsion	State College of Washington
Third	Mark Chappell	Radial Velocity Distribution in Two-Dimensional Curved Channel Flow	University of British Columbia
Fourth	Carl Fullman	Improvement of Solar Energy Collector	Oregon State College
Old Guard	Roger Thieme	Centrifugal Separators: New Concept for Tomorrow's Harvesters	University of Idaho

REGION VII, PACIFIC SOUTHWEST, UNIVERSITY OF SANTA CLARA, SANTA CLARA, CALIF., APRIL 18–19, 1958

Attendance: 121 Papers Presented: 11

Prize	*Recipient*	*Title of Paper*	*College*
First	Harry Hollingshaus	Changes in the Mechanical Properties of Bone Due to Internally Deposited Radioelements	University of Utah
Second	Douglas G. Brian	An Approach to Aluminum Welding	University of Utah
Third	James L. Constanza	Shock-Tube Instrumentation	University of California
Fourth	Harold J. Kopp	Study of Low-Frequency Cavitation	University of Santa Clara
Old Guard	Ken Schneider	A Suggestion for the Improvement of Refining Heat Exchanges	University of Southern California

REGION VIII, NORTHERN TIER, KANSAS STATE COLLEGE, MANHATTAN, KAN., APRIL 28–29, 1958

Attendance: 218 Papers Presented: 12

Prize	*Recipient*	*Title of Paper*	*College*
First	Darrell M. Hosler	The Effect of Tail Fins on Automobile Stability	Kansas State College
Second	Clyde H. Sprague	The Experimental Determination of Rocket Performance	Kansas State College

(Continued from page 133)

Third	James L. Weaver	High-Speed Cam Design	University of Nebraska
Fourth	Leroy J. Krzycki	Rocket Propulsion	University of Nebraska
Old Guard	Allen B. Shockley	Aluminum Production	University of Arkansas

REGION VIII, SOUTHERN TIER, SOUTHERN METHODIST UNIVERSITY, DALLAS, TEXAS, APRIL 24–26, 1958

Attendance: 115 — Papers Presented: 18

Prize	Recipient	Title of Paper	College
First	John M. Metcalf	A Qualitative Analysis of the Operation of an Aircraft-Engine Inlet and By-Pass System for Supersonic Flight	Southern Methodist University
Second	Leo T. Effenberger	A New Fuel-Injection System	A.&M. College of Texas
Third	Jimmy D. Hestand	Valve-System Components of High-Speed Engines	Texas Technological College
Fourth	Cecil R. Shearer	Low-Temperature Refrigeration	University of Texas
Old Guard	Charles W. McHugh	Industrial Applications of Sense of Smell	University of Texas

REGION VIII, ROCKY MOUNTAIN TIER, NEW MEXICO COLLEGE OF A.&M.A., STATE COLLEGE, NEW MEX., APRIL 10–12, 1958

Attendance: 129 — Papers Presented: 9

Prize	Recipient	Title of Paper	College
First	Alan E. J. Branigan	Changes of Isolating Characteristics of Rubber Under Dynamic Conditions	University of Colorado
Second	Lewis C. Lewton	The Performance of a Low-Temperature Solar Still	University of Wyoming
Third	Floyd H. Mathews	Some Current Developments in Fusion Power	University of New Mexico
Fourth	John S. Lyle	Re-refining Used Crankcase Oil	Colorado State University
Old Guard	Ira A. Hartman	Problems Encountered in Climatic Conditioning of Missiles	New Mexico College of A.&M.A.

ASME CODES AND STANDARDS WORKSHOP

Report on Meeting of ISO/TC 1, Screw Threads

By R. P. Trowbridge

The importance which American industry attaches to the desirabilities of world-wide recognition of the Unified Screw Thread system is evidenced by the size of the delegation which attended the ISO/TC 1 meeting on screw threads this past June in Harrogate, England. The delegation, which was acting under the auspices of ASA Sectional Committee B1, was composed of I. H. Fullmer, U. S. Department of Commerce; W. G. Waltermire, Lamson & Sessions Company; E. J. Heldmann, Holo Krome Screw Corporation; R. M. Byrne, U. S. Machine and Cap Screw Bureaus; R. B. Belford, Industrial Fasteners Institute; W. H. Gourlie, Sheffield Corporation; G. A. Stimson, Greenfield Tap & Die Company; J. W. McNair, American Standards Association; Frank Philippbar, The American Society of Mechanical Engineers; and R. P. Trowbridge, General Motors Corporation, chairman of the delegation.

Before giving details of what transpired at the meeting at Harrogate, a brief review of the ISO/TC 1 activity prior to the June meting is in order. ISO/TC 1 early went on record to the effect that in the diameter range of 0.9 to 5 mm it would be preferable to establish a single series of threads approximating the diameter-pitch combinations available in the BA, metric, or national fine. This resolution was subsequently carried out in ISO Draft Recommendation No. 84 which also established the ISO thread profile which is the same as the Unified thread profile. Recommendation No. 84 later became a part of the general plan for metric screw threads, ISO/TC 1 Document No. 143. Diameter and pitches for sizes 5.5 mm and above also formed a part of Document No. 143. All of the threads of this document were metrically conceived and expressed in metric units.

At the ISO/TC 1 meeting in Lisbon in May, 1957, the British in co-operation with the Canadian and U. S. delegates sponsored ISO adoption of threads of the Unified system in sizes $^1/_4$ in. through 6 in. This proposal was accepted in principle with the understanding that it was to be circulated to all member countries of ISO/TC 1 for comment. Also, at the Lisbon meeting it was resolved that the ISO screw thread recommendations should offer general plans for both metric and inch screw threads with a selection of sizes from each general plan for application to bolts, nuts, and screws, and eventually a selection from the metric and inch bolt and nut screw threads for listing as preferred ISO screw threads for bolts, nuts, and screws.

In the seven months prior to the Harrogate meeting, members of Subcommitte 11 (B1) on International Co-operation completed a proposal for inch screw threads based on the present Unified and American standard which included all sizes of the Unified screw threads and the numbered size coarse and fine series based on the Unified formulation. (The numbered sizes are now in the process of being accepted as Unified on the same basis as sizes $^1/_4$ in. and above by the British and Canadians.) The proposal, which was to be presented jointly by the U. S. and Canada also recommended the use of the coarse and fine series threads for bolts and nuts. Prior to departure from the U. S., the American delegation met in April and May to develop arguments and determine what data would be required to support the U. S. position in ISO/TC 1 and ABC meetings. (Subsequent to the ISO meetings, the American delegation continued discussions with the British and Canadians in London on ABC unification topics.)

In presenting the American document ISO/TC 1-142 the need for a series of inch screw threads paralleling the already accepted metric screw threads for sizes about 1.4 mm to 5 mm was emphasized by the American delegation. It was

Other Prizes Presented at the Student Conferences for 1958

1 Two prizes of $25 and $15 were awarded at each conference to the Student Section having the largest and next largest percentage of Student Members attending.

2 A certificate was presented at each conference to the Student Section having the largest percentage of potential Student Members in the third through sixth years among Student Sections participating.

3 Each conference presented a Man-Mile Trophy to the Student Section who has traveled the greatest number of miles to the conference. The winners are listed in the following table:

Region	*$25*	*$15*	*Potential Student Membership Certificate*	*Man-Mile Trophy*
I	Northeastern University	University of Vermont	University of Vermont	University of Vermont
II	Rutgers University	City College of New York Newark College of Engineering	Rutgers University	No winner mentioned
III	Howard University	Villanova University	University of Delaware	Howard University
IV	University of South Carolina	North Carolina State College	Duke University	North Carolina State College
V	University of Dayton	Ohio Northern University	Ohio Northern University	University of Dayton
VI-Northern Tier	South Dakota State College	Iowa State College South Dakota State College	University of North Dakota	South Dakota State College
VI-Southern Tier	Missouri School of Mines and Metallurgy	Bradley University	Rose Polytechnic Institute	Missouri School of Mines & Metallurgy
VII—Pacific Northwest	University of Idaho	Oregon State College	University of British Columbia	University of Idaho
VII—Pacific Southwest	University of Utah	University of California	University of Nevada	University of Utah
VIII—Northern Tier	University of Nebraska	University of Kansas	Kansas State College	University of Oklahoma
VIII—Southern Tier	Texas Technological College	Southwestern Louisiana Institute	Southwestern Louisiana Institute	No winner mentioned
VIII—Rocky Mountain Tier	University of Wyoming	Colorado State University	Colorado State University	University of Wyoming

pointed out that the system of inch screw threads would be incomplete without carrying the sizes down to a point where the national miniature screw threads start. It was noted that the system as presented was now being followed in the U. S. A., Canada, United Kingdom, and in many other countries. This contention was substantiated by presentation for review by TC 1 members of a considerable sampling of American catalogs and screw thread standards showing the extent to which the Unified thread had achieved acceptance in the U. S.

In the meeting the discussion of the sizes $^1/_4$-in. diam and over and sizes below $^1/_4$-in. diam were separated in view of resolutions passed at Lisbon on acceptance of the larger sizes. Without much difficulty the new proposal for sizes $^1/_4$ in. and larger was accepted as superseding the earlier document, it being noted that the latest proposal incorporated more rational grouping of sizes in the uniform pitch series and that size increment gaps $1^1/_2$ in. and 2 in. had been filled.

As had been anticipated, the opposition to the sizes below $^1/_4$ in. was strong. As the discussion progressed, those countries sponsoring the metric threads indicated a willingness to accept the numbered size inch threads on a temporary basis; however, the American delegation indicated that for the Americans to support this viewpoint would be misleading in that there was no apparent tendency in the U. S. or Canada toward use of metric threads in the size range of the numbered inch threads. The resolution finally agreed on after much debate reads as follows:

"TC1 Resolution 54: ISO inch screw threads with diameter below $^1/_4$-in. (8 Harrogate 1958) TC1 confirms that the aim fixed by TC1 Resolution 8 (3 New York 1952) could be fulfilled by Draft ISO Recommendation No. 84, but in view of the actual situation, accepts as a parallel the sizes below $^1/_4$-in. diam in TC1 Document 142 R as a first draft proposal."

This resolution was accepted with but three abstentions.

At the Lisbon meetings, in 1957, ISO/TC 1 had accepted the UNC and UNF designations to apply to the Unified coarse and fine threads respectively. At the Harrogate meeting TC 1 accepted the UNEF and UN designations to apply

ISO/TC 1, Screw Threads, in session at Harrogate, England. American delegation, shown in insert clockwise, includes E. J. Heldman, Mem. ASME; R. B. Belford; I. H. Fullmer, Fellow ASME; W. H. Gourlie, Mem. ASME; R. P. Trowbridge, Mem. ASME and chairman of delegation; Frank Philippbar, Mem. ASME; G. H. Stimson, Mem. ASME; and Robert Byrne. Overheard at this session *ISO Courier* reports as follows: "We French and Indians must stick together to defend the metric system. If necessary, we shall fight for it inch by inch."

to the extra fine series and the uniform pitch series respectively. The Committee also recommended that for an interim period, the Unified tolerances, according to ASA B1.1, should apply to ISO inch screw threads and that tolerances derived from the DIN standards should apply to ISO metric screw threads. However, it is the hope of ISO/TC 1 Working Group 2, Subgroup 1, that a single system of tolerances independent of the system of measurement should be the ultimate aim of TC 1.

In this recommendation there was unanimous concurrence.

Among other resolutions passed by TC 1 were appointment of the U. S. A. as a member to the Tolerance Group—Working Group 2, Subgroup 1, and to the Research Group—Working Group 4.

These resolutions were approved by the American delegation with the understanding that implementation would be subject to approval by ASA Sectional Committee B1.

In summation, the first steps toward recognition of the complete Unified standards as international standards have been accomplished. The extent to which the Unified screw thread standard gains acceptance outside the areas in which it is now used will depend largely on the degree to which its use is promoted by wide dissemination of American, British, and Canadian design practices and products outside the sphere of the inch-using countries. Another equally important influence on further acceptance of the Unified screw threads and American screw thread technology in general will be the extent to which the U. S. co-operates with the Working Groups of ISO/TC 1.

Report on Meeting of ISO/TC 29, Small Tools

By Frank P. Brown

On June 30, 1958, *Time* magazine published an article entitled "Industrial Conformity—It Can Help Bring More World Trade." (See page 137 of this magazine.—Editor.) It was a telling argument, urging greater participation by U. S. industry in the work of the International Organization for Standardization, not for the sake of better international relations, but for the sake of American industry itself.

As a delegate representing the U. S. A. at the April 28, 1958, meeting of ISO/TC 29, I saw at first hand what *Time* was talking about.

Technical Committee 29 is the international committee working on small tools. The national standards organizations of 18 countries are members.[1] It is an active committee, with 18 working groups developing detailed recommendations on specific small-tool problems. Some of these groups include twist drills, files and rasps, reamers, shank diameters, screwing taps, turning tools with carbide tips, drill chuck tapers, and milling cutters. Although American industry is officially participating in the work of TC 29 through the American Standards Association, it has taken no active part in the work, and is not a participating member of any of the Working Groups. This year U. S. A. had a representative at the plenary meeting of TC 29, and at the same time, arrangements were made for the U. S. A. representative to attend the meeting of Working Group 4 on Screwing Taps.

As the U. S. A. delegate, I found these meetings offered an unusually interesting experience. National standards organizations of 12 countries were represented during at least some of the sessions of the main committee: Austria, France, Germany, Hungary, Italy, The Netherlands, Poland, Sweden, Switzerland, United Kingdom, United States, and USSR.

All these delegates showed unusual interest and earnestness in attempting to achieve international agreements on technical problems. They expressed an obviously genuine desire that the U. S. A. (the ASA) participate actively in the plenary meetings of the Technical Committee and also in the several working groups.

From the viewpoint of American industry's own interests it would be desirable that we participate more actively for a number of reasons:

1 It should stimulate the sale of tools on the European market that are manufactured by American plants located abroad as well as in the U. S. A.

2 It should reduce the possibility of the adoption of ISO standards which may result in a diminishing export market for the United States.

3 In participating, the United States would lend emphasis to the incorporation of English measurement units in ISO/TC 29 standards. Strong pressure toward the use of metric units is currently evident.

4 It would assist in dispelling an attitude of aloofness which some of the countries apparently feel the U. S. exhibits in not actively participating in ISO/TC 29 work. From a national standpoint, more active participation is desirable during this period of tension.

5 Appropriate representation would give the opportunity to present the American viewpoint on international standards in a personal manner resulting in better understanding of such viewpoints by the European people. It would also serve to keep our industry up to date on what is going on in other countries and thus provide broader overall viewpoints and mutual understanding.

If we do establish a more active policy of participation, we could benefit by selecting our delegation carefully with the needs of the job in mind.

At the plenary meeting of TC 29 in Berlin, a number of draft proposals were approved as Draft ISO Recommendations. These will now be submitted to the ISO General Secretary for circulation to all ISO member-bodies. If they are approved by 60 per cent of ISO member-bodies, they will be sent to the ISO Council for approval as ISO Recommendations. The ISO Recommendations are what their name implies. They are recommendations to the national standards bodies of the various countries for possible adoption or incorporation in their national standards, with the view to bringing about greater uniformity of practice.

Draft ISO Recommendations were approved by the committee on the following: files and rasps; reduction sleeves and extension sockets for tools with Morse tapers; twist drills, reamers; shank diameters and driving squares for tools; sections and tolerances of shanks for turning and planning tools; carbide tips for turning tools, metric sizes; turning tools with carbide tips, metric sizes; drill chuck tapers.

TC 29 also authorized a number of the groups to take up additional work. Clearer definitions of the shapes of files are to be developed by the Working Group on Files and Rasps. Also, further simplification is to be studied as well as the possibility of reducing the minus tolerances in order to facilitate sharpening of files.

The Working Group on Twist Drills will add to its program a study of the choice of drill diameters in relation to usage.

Each of the members of the Working Group on Shank Diameters and Driving Squares for Tools agreed to impress on interested manufacturers in his country the need to put the ISO Recommendation into effect quickly as soon as it is given final approval.

A draft proposal based on British and American Standards is being prepared by the Working Group on Screwing Dies.

A preliminary table of general dimen-

[1] Austria, Belgium, Canada, France (Secretariat), Germany, Hungary, India, Italy, The Netherlands, Norway, Poland, Portugal, Switzerland, Sweden, Czechoslovakia, United Kingdom, U. S. A., USSR.

sions of taps for conical threads was circulated to members of the Working Group on Taps for Pipe Threads. This table was prepared by the British Standards Institution's Committee on Fastening Threads, and applies to fastening threads covered in British Standard 2779:1956 and British Standard 21:1957. It was pointed out that in British Standard 21:1957, two systems of gaging are included, one in accordance with current American practice, and the other following the British practice.

TC 29 is asking inch-using countries either to adopt the Draft ISO Recommendation on Carbide Tips for Turning Tools, Metric Sizes, when converted into inches with sufficient precision to ensure practical interchangeability, or on the contrary, to adopt dimensions and denominations quite different in order to avoid risk of confusion.

Working Group 4 on Screwing Taps will collect information from members on current practices regarding tolerances on threads of screwing taps. This working group has approved marks for taps to show tolerance of tap thread, indication of the left-hand thread, and the order in which serial taps are to be used. The type of steel is to be marked at present in accordance with the practice in each country. ISO TC 37 is preparing recommendations on terminology and may recommend symbols for different types of tool steels. Working Group 4 will wait for action by TC 37. A new investigation will be carried out by Working Group 10 on Milling Cutters under the auspices of TC 29 to try to find close agreement between the inch and metric values on the average of outside diameters.

All of this activity on the part of TC 29 and its working groups has been reported to the Steering Committee of Sectional Committee B5 on Small Tools and Machine Tool Elements and it is understood it will be presented at the next meeting of Committee B5. The report includes the recommendation that the committee make arrangements to work more closely with TC 29. Particularly, it is recommended that the committee arrange to have representation at future meetings of TC 29 and as many of its working groups as possible.

Report on Meeting of ISO/TC 39, Machine Tools

By A. W. Meyer

The 1958 Plenary Session of ISO was held at Harrogate, England, June 9-12. During this period ISO/TC 39 on Machine Tools met from Monday, June 9, through Friday, June 13, to give atten-

INDUSTRIAL CONFORMITY

It Can Help Bring More World Trade

AS THE father of mass production, U.S. business pioneered in standardizing thousands of parts and products to spur sales and cut costs. It set up specifications, for example, so that a light bulb would fit the socket no matter who made it. But while showing the world the benefits of standardization, U.S. firms have done a poor job in helping set up worldwide standards. They have left the field largely to other nations, simply because many U.S. businessmen are unaware of the importance such standards play in world trade. This importance was emphasized last week as 1,000 delegates from 40 countries met at Harrogate, England, to bring the world closer to conformity on everything from screw threads to nuclear reactors. Eventually, their decisions will have repercussions from the board rooms of Krupp to the Kremlin, affect housewives from Minneapolis to Vladivostok.

The need for international standards was recognized 50 years ago but did not attract worldwide attention until World War II. In 1947, shortly after the International Organization of Standardization was formed, doctors discovered that an order of Swedish hypodermic needles rushed to epidemic-stricken Egypt did not fit U.S. syringes in use there. Needles to fit eventually arrived—but not until hundreds of victims had died of cholera. Since then, the organization, working through scores of national standards groups, has approved 58 worldwide standards for everything from musical pitch to the abrasion resistance of rubber.

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U.S. firms have often taken notice of international standards only when they were being hurt. The U.S. movie industry fought for and got an international film standard based on U.S. standards (with the sound track on the left edge of the film as it goes through a projector) only after the Germans ate into its foreign markets and threatened to establish German standards with the sound track on the other side. Result: U.S. movie companies can distribute worldwide, get 50% of their income from abroad.

Though U.S. firms, in a belated awakening, sent 60 delegates to Harrogate, they have taken the lead in developing only nine world standards. They have not worked at all on 58 of the 142 draft recommendations for standards now being considered, including standards for such big export items as steel and textile machinery. Many standards may therefore be set up contrary to U.S. design, shutting U.S. goods out of nations that adopt them as effectively as do high tariffs, currency restrictions or import quotas.

Since U.S. industrial technology leads the world, many nations could easily be persuaded to adopt U.S. standards as international, thus open up new markets for U.S. products. But while U.S. businessmen have dallied, the world has not waited. Great Britain, France and The Netherlands have taken the lead in standard setting, and even Russia has participated in one-third more standardization conferences than the U.S. Young industrial nations are already finding it easier to adopt British, French or even Russian rather than U.S. standards. In the last ten years, India has adopted some 1,000 national standards; most were British, only a few American.

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U.S. industry has not even taken the trouble—or spent the money—to have its 1,700 national standards translated for use in foreign countries. In Latin America, where the U.S. is the biggest trader, few standards exist. But it is European businessmen instead of U.S. firms who are translating their standards into Spanish and Portuguese in a drive to grab a bigger slice of its growing market.

U.S. firms have already been hurt by not taking part in fixing worldwide standards. They ignored international proposals to govern the size of grooved pulleys and V-belts, later found that the standards adopted were detrimental to U.S. products. Now the U.S., through its American Standards Association, is vainly trying to have the recommendation changed. American businessmen did not participate in discussions for uniform cast-iron pipe specifications, stood back while standards were approved that do not mesh with those in the U.S. Result: U.S. industry has lost business, especially in South America. A major U.S. pipe company recently could not fill an order to Venezuela, for example, because of the difference in specifications.

Most U.S. companies, geared to big production, cannot profitably change their products to meet foreign standards for export orders. But smaller foreign companies often find it worthwhile to change their products to conform to U.S. standards so that they can go after the big U.S. market. Said H. Thomas Hallowell Jr., president of the American Standards Association: "It is no coincidence that American industries doing the largest export business—the electrical and motion-picture industries, for example—are the ones that have helped develop international standards."

Reproduced from *Time*, June 30, 1958, page 76.

tion to the various projects that it has under consideration.

TC 39 was but one of 15 technical committees scheduled to hold meetings at Harrogate at which some 400 representatives from 35 nations were in attendance.

ISO/TC 39 sessions were presided over by either M. P. Salmon or M. Meriel-Bussy of France. Seventeen countries and some 40 persons were in attendance, including interpreters.

Prior to the meeting at Harrogate the ASA had sent the written points of view held by the U. S. A. on ISO documents, including the following:

112E—Tapers for Tool Shanks.

113E—Centers for Lathes or Other Machine Tools.

114E—Lathe Tool Posts.

115E—T-Slots for Machine Tools.

116E—Machine Tool Feeds and Speeds.

Written comments on ISO Document 119E on Machine Tool Test Code were submitted prior to the meeting so the foregoing was all a matter of record.

The conclusions reached on these items at Harrogate were as follows:

Tapers for Tool Shanks. These are open questions on which the United Kingdom, Germany, and we are not in full agreement and we are all to review these and by correspondence try to arrive at a solution to the minor differences.

Centers for Lathes. This proposal has been approved after we suggested the title be limited to Lathes. The title was at one time broadened to include other machine tools, such as grinding machine centers, without increasing the tables, but finally the limited data in the proposal were accepted with a corresponding restriction in the title.

This action appears satisfactory and there seems no further action required by us at this time.

Lathe Tool Posts. This proposal was acceptable to us, was passed at Harrogate, and no further action is required.

T-Slots for Machine Tools. There is some minor lack of interchangeability between ASA B5.1-1949 and the metric equivalent tables. Germany has made an effort to meet the ASA dimensions but two points still require study and it was left that the U. S. A. would study this situation and see if we cannot come to some agreement with Germany.

Machine Tool Feeds and Speeds. We advised the Secretariat that we did not approve this proposal and in fact our opposition was made well known to all nations, in 1952 at New York, later at London verbally by Tell Berna, followed by our written statement a few years ago. The U. S. A. and The Netherlands were the only two nations that had no use for this and it was evident we were definitely in the minority. A resolution was passed in which it was stated that the U. S. and The Netherlands found this "not desirable." There apparently is nothing further we can do about this. It would appear that while this may become an ISO Recommendation some time in the future, it will not become an ISO Standard in view of our objection and those of the The Netherlands.

Machine Tool Test Code. This, with editorial changes met with approval of all countries present at Harrogate. There is no further work involved here for us at this time.

Direction of Rotation of Controls. Several different proposals were considered and we asked for further time to consider the many aspects of these proposals and are given the opportunity to submit our proposal.

Lathe Spindle Noses. There is a definite split opinion on the merit of ASA B5.9-1953 Cam Lock and the Bayonet Lock. Practically all nations are in favor of our A_1 standard but are divided on the balance. United Kingdom has a Flange Spindle which is quite popular and there was a long discussion of the merits of our A_1, A_2, long nose, etc., designs, and the U. S. is to write the French Secretariat as to the extent of use of the various noses given in our ASA B5.9 standard, the advantages of each, and any other technical information pertinent thereto. Russia will write similarly on the Bayonet Type.

Fits of Grinding Wheel Bores and Machine Spindles.

Flanges for Grinding Wheels. These were considered at Harrogate and there remains some work for us to do on these projects. It would appear that the NMTBA and the Grinding Wheel Institute are primarily involved. We should study the problems presented at Harrogate and firmly establish the U. S. position with the French Secretariat in order that any forthcoming proposals will be to our liking.

The question of establishing a standard for wheel-spindle ends was also brought up but in view of the fact that this had no connection with the fitting of wheels to flanges, was ruled out of order.

Driving Squares. ISO/TC 29 on Small Tools has prepared a Draft ISO Recommendation on driving devices and it was proposed that ISO/TC 39 Working Group 3 make an inquiry on the possibility of international standardization of driving squares for handwheels, crank handles based on the same series of numerical values for tools, to allow the use of the same tools and gages.

Symbols on Machine Tool Indication Plates. The French Secretariat had prepared a 12-page report presenting 75 symbols for Plates. In this report the German DIN proposals were also listed where there were differences involved. Supplementing these, suggestions were received from Hungarian and Polish delegations which were also considered.

At the previous meeting in Paris of 1957 this problem was considered and since then the NMTBA under the leadership of Charles Blake of Warner & Swasey, had started working on this problem.

I reported at Harrogate that we had not had sufficient time to prepare a proposal on behalf of the United States, that we were seriously interested in this project, that our study indicated that some essentials had not been considered and requested time to present our material, which should prove to be helpful to all nations.

The Chairman pointed out that the French Secretariat had one idea, the German another, the Polish still another, and so on—some were generic presentations, some symbolic, others geometric in nature and there was quite a state of confusion. It appeared that geometric symbols were more in favor than symbolic.

The United States was given to understand that if we decided to submit a proposal we should point out the reasons for our suggestions and as to why they are considered better than the ISO report. Our proposal should be prepared promptly and sent to the French Secretariat.

The next meeting of this group it was suggested be held about the time of the next European Machine Tool Show in order to conserve on travel time and expenses and also to afford an opportunity of having more than one delegate attend from the U. S. I understand there is to be a show at Paris, Sept. 12–21, 1959, but perhaps due to lack of new facilities at Paris the show may be held elsewhere.

In conclusion I believe the industrial importance of the United States in the machine-tool field is such that we should take an active part in this work. The ISO is organized so it can function to good advantage and we should place ourselves in the position of assisting in this work. The French Secretariat, as well as other nations, looks to us for guidance and advice. We have the technical ability and are capable of participating in the program and it is far better to cooperate in the various projects under development and arrive at a Recommendation that meets with our approval and complies with our national practice than to find ourselves confronted with Rec-

ommendations not to our liking, and prove costly from compliance standpoint.

I think Sir Roger Duncalfe, President of ISO, made a good statement when he said in his opening remarks that—"indeed no country to-day can afford the luxury of not being a member of ISO." The United States is a member of ISO and as such we can even less afford not to actively participate in its work and deliberations.

International Standardization in the Field of Nuclear Energy

By H. A. Wagner

AN article in a recent issue of *Time* expressed the need for U. S. businessmen to become more aware of the fact that they should participate more actively in the field of standardization, especially on an international level. (See page 137 of this magazine.—Editor.) The American Society of Mechanical Engineers has, for many years, taken an active interest in standardization, not only on a national but on an international level as well.

The ISO, recognizing the need for an early undertaking of international standardization in the field of nuclear energy, established in July, 1956, a Technical Committee on Nuclear Energy which they designated as ISO/TC 85. The ASA, as the United States Member Body of the ISO, was invited to undertake the secretariat of this technical committee and accepted the invitation. Two meetings of ISO/TC 85 have been held—the first at Geneva, Switzerland, in July, 1957, and the second at Harrogate, England, in June, 1958. The ASME was represented at both meetings.

At the first meeting in Switzerland, there were 61 delegates from 13 countries, observers from four more, and representatives from seven international organizations in attendance. Under the chairmanship of Morehead Patterson, Mem. ASME, chairman and president of the American Machine and Foundry Company, the technical committee at that time was divided into working groups (later designated as subcommittees) led by the U. S. A., France, and the United Kingdom. These groups took initial steps towards:

1 Development of a trilingual glossary of terms applicable to nuclear energy, based on work already done in various countries.

2 Development and approval of a warning symbol for use wherever danger from ionizing radiation is present.

3 Adoption of units pertaining to nuclear energy, developed by the International Commission on Radiation Protection and the International Commission on Radiological Units.

4 Development of symbols required for drawings pertaining to nuclear equipment and installations.

5 Development of international recommendations relating to measurement of radiation and protection against radiation.

6 Development of internationally acceptable guides for safe design, operation and maintenance of nuclear reactors.

Three of these subcommittees are now active:

1 Terminology, definitions, units and symbols, with the U. S. A. as secretariat.

2 Radiation protection, with France as secretariat.

3 Reactor safety, with the UK as secretariat.

A fourth subcommittee was organized at the June, 1958, meeting to develop international recommendations on radioisotopes, with Poland holding the secretariat.

At the June, 1958, meeting of Subcommittee 3 on Reactor Safety, there were 55 delegates in attendance from 15 countries and representatives from six international organizations. Since the UK holds the secretariat for this subcommittee, they had prepared seven draft proposals for consideration, as follows:

(*a*) List of features relating to safety of land-based reactors.

(*b*) Reactivity status of the reactor.

(*c*) Classification of wastes and general principles relating to their collection and treatment prior to disposal.

(*d*) Behavior of the reactor in relation to coolant.

(*e*) Handling the material from the nuclear reactor core and blanket.

(*f*) Operator qualifications and supervision.

(*g*) Records required to insure safety in the operation of gas-cooled nuclear reactors.

Three documents were presented for consideration by the United States, as follows:

(1) Notes on reactor site selection by R. O. Brittan of ANL.

(2) Nuclear safety guide issued in 1956 as a classified document, prepared by Los Alamos, and since declassified.

(3) A review of present American design of containment vessels for nuclear power plants, by Alf Kolflat.

Most of the proposals presented, however, had not been submitted sufficiently in advance of the meetings to enable an exhaustive discussion. A number of comments were offered and further consideration will be given to each of the proposals presented. Progress will undoubtedly be slow, and will follow work done by the standardization bodies in the respective countries. However, a good start has been made on a project which should prove most worthwhile in the long run.

Shortly after the return of the U. S. delegates, from the meeting at Harrogate, the ASA Sectional Committee N6 on Reactor Safety Standards, sponsored by ASME, held a meeting to discuss among other items the meetings of the ISO. At that time, copies of draft proposals submitted to ISO Subcommittee 3 on Reactor Safety were distributed to the members of this ASA committee so that they might give them further study in the work of the committee.

Smog News Five Years Old—Editor Reviews Developments

A RADICAL change in the nation's attitude toward air pollution was documented recently on the fifth anniversary of *Smog News*, a semimonthly publication of The American Society of Mechanical Engineers. During the past five years, said Frederick S. Mallette, the newsletter's editor, emphasis has shifted from relatively simple problems such as smoke and fly ash to the much more complex problems usually associated with the word "smog." In addition, more cities have become concerned with air pollution and control budgets have grown enormously.

The review of developments in the field on air pollution was issued by Mr. Mallette, secretary of the Air Pollution Controls Committee of ASME and editor of *Smog News*.

"In contrast to the simple problems of smoke and fly ash dealt with in *Smog News* five years ago we now find news items on a wide variety of problems, from automobile exhausts to odor meters," said Mr. Mallette. At that time, only Los Angeles was then worrying about "smog" which had come to mean a complex mixture of air pollutants rather than a mixture of *smoke* and *fog*, its original definition. Today, concern over air pollution is no longer limited to a few cities. There is hardly a town of any importance which does not have an active interest in air pollution.

Practically every state in the Union and Hawaii are represented by state health-department activity. Mr. Mallette said, "Air pollution budgets

Keep Your ASME Records Up to Date

The ASME Secretary's Office depends on a master membership file to maintain contact with individual members. This file is referred to countless times every day as a source of information important to the Society and to the members involved. All other Society records are kept up to date by incorporating in them changes made in the master file.

The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.

Your membership card includes key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you have expressed an interest. Consult the form on this page for the Divisions to which these letters pertain. If you should wish to change the Divisions you have previously indicated, please so notify the Secretary.

It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.

Please complete the form, being sure to check whether you wish mail sent to your residence or office address, and mail it to ASME, 29 West 39th Street, New York 18, New York.

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POSITION TITLE NATURE OF WORK DONE

e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

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Address changes effective when received prior to:

☐ Mechanical Engineering	10th of preceding month
☐ Transactions of the ASME	20th of preceding month
☐ *Journal of Applied Mechanics*	20th of preceding month
☐ *Applied Mechanics Reviews*	1st of preceding month

Professional Divisions in which I am interested (no more than *three*) are marked X.

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☐ D—Materials Handling	☐ M—Production Engineering	
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ V—Gas Turbine Power
☐ F—Fuels	☐ O—Lubrication	☐ W—Wood Industries
☐ G—Safety	☐ P—Petroleum	☐ Y—Rubber and Plastics
☐ H—Hydraulics	☐ Q—Nuclear Engineering	☐ Z—Instruments and Regulators
	☐ R—Railroad	

today are important municipal expeness with Los Angeles County topping the list at almost $4 million a year. New York City spends approximately $670,000, the San Francisco Bay Area almost half a million dollars, and the California State Department of Health over $350,000. Expenditures by industry for control measures, as shown in *Smog News*, are also staggering with a recent report of $12 million for just one plant of a large steel company. Sums in the vicinity of $50,000 for incinerator or odor problems are found frequently."

In its present form, *Smog News* covers a wide variety of air-pollution problems. It features reproductions of news clippings about industrial pollution, agricultural damage, incinerator and odor problems, and related subjects.

The newsletter began as an information bulletin for members of the ASME Air Pollution Controls Committee. Within a few months, so many requests for it were received that the mailing list grew from its original size of 40 to hundreds. The committee then offered the magazine on a subscription basis. Almost all of the n.wsletter's readers became charter subscribers at $6 for the 24 issues a year.

1959 Mechanical Catalog Ready for Distribution

Commencing October 1, copies of the 1959 "Mechanical Catalog" will be mailed to those members of The American Society of Mechanical Engineers who have already requested the new edition.

Designed as an aid in specifying and buying functions, it contains over 50,000 listings, 6000 products of 3500 manufacturers, plus more than 300 pages of descriptive advertising matter of importance to the engineer in industry.

Since 1912, the Mechanical Catalog has been an invaluable reference for engineers in industry. Constant editing of listings, industry-inspired phraseology revisions, and a continuing flow of suggestions from industry have helped make the Catalog the most influential of its kind.

One important feature of the 1959 edition is the 20-page descriptive listing of all ASME publications, which enables engineers to check quickly their requirements for the latest standards and codes as well as other special data.

Copies of the 1959 Mechanical Catalog are still available to ASME members upon written request.

October 9–10

ASME-AIME Fuels Conference, Hotel Chamberlin, Old Point Comfort, Va.

October 13–15

ASME-ASLE Lubrication Conference, Statler-Hilton Hotel, Los Angeles, Calif.

November 30–December 5

ASME Annual Meeting, Statler-Hilton and Sheraton-McAlpin Hotels, New York, N. Y.

March 8–12, 1959

ASME Gas Turbine Power Conference and Exhibit, Netherlands-Hilton Hotel, Cincinnati, Ohio

March 8–12, 1959

ASME Aviation Conference, Statler-Hilton Hotel, Los Angeles, Calif.

ASME COMING EVENTS

March 29–April 1, 1959

ASME Instruments and Regulators Conference, Case Institute of Technology, Cleveland, Ohio

April 5–10, 1959

Nuclear Congress, Cleveland Auditorium, Cleveland, Ohio

April 13–15, 1959

ASME Hydraulics Conference, University of Michigan, Ann Arbor, Mich.

April 19–23, 1959

ASME Oil and Gas Power Conference, Shamrock-Hilton Hotel, Houston, Texas

April 23–24, 1959

ASME Management-SAM Conference, Statler-Hilton Hotel, New York, N. Y.

April 29–May 3, 1959

ASME Metals Engineering Conference, Sheraton-Ten Eyck Hotel, Albany, N. Y.

May 4–5, 1959

ASME Maintenance and Plant Engineering Conference, Edgewater Beach Hotel, Chicago, Ill.

May 12–14, 1959

ASME Production Engineering Conference, Statler-Hilton Hotel, Detroit, Mich.

May 25–28, 1959

ASME Design Engineering Conference, Convention Hall, Philadelphia, Pa.

June 14–18, 1959

ASME Semi-Annual Meeting, Chase-Park Plaza Hotel, St. Louis, Mo.

June 18–20, 1959

ASME Applied Mechanics Conference, Virginia Polytechnic Institute, Blacksburg, Va.

August 9–12, 1959

ASME-AIChE Heat-Transfer Conference, University of Connecticut, Storrs, Conn.

September 17–18, 1959

ASME-AIEE Engineering Management Conference, Statler-Hilton Hotel, Los Angeles, Calif.

September 20–23, 1959

ASME Petroleum Mechanical Engineering Conference, Rice Hotel, Houston, Texas

November 29–December 4, 1959

ASME Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

(*For Meetings of Other Societies, see page 114*)

Note: Members wishing to prepare a paper for presentation at ASME national meetings or divisional conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for which there is no charge providing you state that you are a member of ASME.

How Well Do You Know Your Society?

So that the members of ASME may know their Society, attention is called to the list of Manuals and Annuals available upon request from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Unless otherwise noted, all the items in the list will be sent without charge.

AC 2	Annual Report of ASME Research
AC 10	Personnel of Council, Boards, and Committees
AM 1	Membership List—Alphabetical and Geographical (Biennial—odd-numbered years)
AM 3	Catalog of Publications (also included in "Mechanical Catalog")
AM 4	Members List—Listed by Companies (Biennial—even-numbered years, $2 each)
AM 5	Indexes to ASME Papers and Publications (Published annually in January issue of *Transactions of ASME*)
MM 1	Certificate of Incorporation, Constitution, By-Laws, and Rules
MS 4	An ASME Paper (50 cents to nonmembers)
MS 61	Citizenship and Participation in Public Affairs

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC [Agency]

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include eight cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

NEW YORK	CHICAGO	DETROIT	SAN FRANCISCO
8 West 40 St.	84 East Randolph St.	100 Farnsworth Ave.	57 Post St.

Men Available[1]

Manager, Service Engineering, or Sales Engineer, BSME; 31; considerable experience in liaison-type of engineering work with a leading manufacturer of electromechanical analog computers and gyrostabilized equipment. Has contact with Air Force. Has supervised engineers dealing with the testing of experimental equipment. Prefers South, Southwest. Me-633-903-Chicago.

Project Manager-Resident Engineer, 20 years' supervision design and construction multimillion power projects, economic studies, and reports. Five years foreign projects. Registered PE. Available December 1. Location immaterial. Me-634.

[1] All men listed hold some form of ASME membership.

Sales or Industrial-Management Engineer, BSME; 34; eight years' experience; methods, plant layout, and sales engineering, plus general administrative assistant studying accounting, order handling, production, manufacturing, and inventory problems. Prefers northern N. J. or New York City. Me-635.

Chief Engineer, BSE; 39; 16 years' industry experience, machinery and fluid-systems design, manufacture, installation, and supervision. Location immaterial. Me-636.

Industrial Engineer, AB Applied Economics, BSME; 31; eight years' experience in development and installation of cost-reduction and control programs in manufacturing, chemical-processing, and construction industries. Location immaterial. Me-637.

Plastics Field Engineer, BNS, BSME; 32; eight years' in plastics industry; field work relative to sales and engineering for customers pertaining to quoting, production methods, cost analyses at all levels. Marketing-survey work. Location immaterial. Me-638-904-Chicago.

Project-Consulting Engineer, BSME, registered; 33; ten years process and utilities-plant design supervision and co-ordination of major projects with consulting firms; one and one half years Zimmermann Process Analysis. Prefers North central or West. Me-639-9885-Detroit.

Application Engineer, BSME, PE; 35; ten years' research and development new mechanical products, fuel preparation, combustion, controls, process equipment. Desires challenging position and opportunity requiring initiative and creative ability. Will relocate as required. Me-640-9891-Detroit.

Plant Engineer, BSME; 34; good background in plant engineering, new construction, machine design, preventive maintenance, cost control, and supervision. Location immaterial. Me-641-905-Chicago.

Assistant to Manufacturing Executive, BS and MS in Industrial Engineering, LLB.; 32; manufacturing analysis, review of manufacturing programs, and project-appropriation requests, two years; supervisor manufacturing engineering and cost-reduction surveys, three years; general industrial engineering, 3 years. Location immaterial. Me-642-9895-Detroit.

Engineering Manager, BAEE, MS, MBA; 38; 14 years' professional experience in planning, co-ordinating, and directing the development of products and manufacturing processes. Widely varied assignments in the automotive, aviation, and appliance field. Activities have included the determination of optimum R&D programs. Prefers Midwest. Me-643-908-Chicago.

Administrative Engineer, BME, MBA Harvard Business School; 24; more than one year' consulting and manufacturing experience; analysis of financial and operating data, planning new facilities, budgets, costs, operations analysis, and production engineering. Preferred New York City, eventually relocate. Me-644.

Research Engineer, BSME; 28; one and one half year research engineer, stress analysis of high-pressure natural gas-transmission lines; four years equipment-inspection engineer, inspection of pressure vessels, piping, heat exchangers, and furnaces. Prefers Midwest or East. Me-645-9892-Detroit.

Positions Available

Chief Development Engineer, mechanical graduate, considerable experience in the design and development of high-speed automatic machinery as used in paper-converting business. Paper experience desirable but not a prerequisite. Some control-system experience desirable. $14,-000, plus bonus. Mich. W-6352.

Assistant Professor, PhD in ME, to teach courses in thermodynamics and allied subjects to junior and senior undergraduates and to graduate students in the master-of-science program. New England. W-6360.

Valve-Design Engineer, college degree in engineering or equivalent experience; several years' actual design experience in the valve field. Must have a strong interest in the practical, industrial aspects of mechanical engineering. Excellent opportunity with a growing company. Salary open. Company reimburses applicant for placement fee. Ohio. W-6374.

Chief Engineer, mechanical or electrical graduate, for a large firm of consulting engineers, to take over a district office. Company is engaged mostly in the design of air conditioning, heating, electric light, and power for commercial, industrial, and institutional buildings. Must be strong on design and management. Salary high. New York, N. Y. W-6384.

Project Engineer, work in research and development for company manufacturing pulp and paper machinery and equipment, graduate mechanical, five years' experience as a mechanical engineer including a minimum of two years as a machinery designer or two years in the pulp and paper industry. Duties will include design and development of new products, redesign, modernization, and further development of existing products, design, and conducting of experiments intended to test and develop new designs. To start, $8000-$8500. Mass. W-6394.

Director of Engineering, graduate mechanical, approximately ten years' or more experience in plant engineering and/or centralized engineering organization handling new construction, plant equipment, layout, and design, etc. Should have good working knowledge of corporate capitalization methods and of operating cost reporting. About $12,000. Central N. J. W-6399.

Engineers. (*a*) Assistant production engineer, seven to ten years' experience in manufacture and design of electromechanical equipment. $10,000, plus. (*b*) Project engineer, graduate mechanical, chemical, or electrical, three to five years' experience in electromechanical equipment particularly applying to processed-paper industry. Upstate N. Y. W-6416.

Research and Development Engineer, mechanical or electrical graduate, approximately five years' experience on the development of electromechanical devices, particularly as to household appliances. $7200-$7800. Conn. W-6427.

Methods Engineer, ME or IE degree, with additional training in electromechanics and instrument-production techniques; three to five years' experience in the methods and processing of electromechanic and electronic components for machine-shop and assembly operations. Duties will include planning from initial concept to follow-up; write process sheets; layout process prints, tool scheduling, machine loading, develop standard data, etc. $7200. Mass. W-6437.

Production Manager, Transformer Plant, fast-growing manufacturer of power and light distribution transformers. Must be capable of assuming full responsibility for production, production control, and personnel supervision. Knowledge of all phases of transformer production necessary. Position will ultimately result in position of vice-president in charge of manufacturing with stock option. Midwest. W-6438.

Sales Engineers. (*a*) Sales engineer, aircraft hydraulics; inside sales; degree in mechanical or aeronautical engineering preferred; strong background and interests along engineering lines. Experience in aircraft or missile industry or in industry supplying aircraft products. Direct experience with projects involving use of hydraulic components; experience in paper work and procedures involved in aircraft-component procurement. To $8500. Relatively little travel. Upstate N. Y. (*b*) Sales Engineer, degree in metallurgical, mechanical, or general engineering, from none to five years' experience in metal-castings sales. Recent graduate acceptable but prefer some foundry experience. Work will be in sales of precision cast, high-strength steel, and iron castings. Involves contact with development and engineering personnel regarding problems involved in casting design and application. To $7800 for experienced sales engineers. Ill. Company may negotiate placement fees. W-6445.

Manufacturing Executive, manufacturer of pipe fittings for power-plant and oil-refinery usage. Must know equipment and methods; be able to plan and direct entire operation; recommend process, equipment, and methods changes; train personnel; control quantity, quality, and costs of production. Excellent opportunity for advancement. Starting salary in accord with present qualifications. Relocation costs paid; placement fee a negotiable item. Apply by letter giving experience, abilities, education, and salary requirements. Midwest. W-6451.

Design Engineer, graduate mechanical or aeronautical engineer, two to four years performance analysis, mechanical, or aerodynamic design; experience with subsonic and supersonic aircraft. Duties will include responsibility for conducting performance and mission analysis to select optimum engine parameters for existing and future propulsions systems; analyzing power-plant component design for applications to new and special devices. To $11,000. New England. W-6460.

Equipment] Specialist, either an ME degree plus two years' experience or its equivalent in five to ten years' experience with a comprehensive knowledge of all classes of chemical and metallurgical-process equipment. Will maintain an efficient and economical program of equipment management covering the proper budgeting; utilization, operation, maintenance, acquisition, control, repair, and replacement for all classes of equipment. To start, $8330. New York, N. Y. W-6462.

Production Engineer, mechanical or metallurgical-engineering graduate, with experience in process and inspection specifications in melting, casting, rolling, and fabrication of nonferrous metals. $10,000-$14,000. New York metropolitan area. W-6463.

Chief Engineer, engineering degree desired, seven or eight years of successful experience in a wide variety of packaging, such as food, cosmetics, etc. Will be responsible for all plant engineering and maintenance activities including new installations, minor construction, maintenance of automatic high-speed packaging equipment, etc.; also for operation and maintenance of high-pressure steam-generating facilities. $10,000-$12,000. N. J. W-6466.

Associate Engineer, graduate mechanical, preferably one to two years' experience, but will consider a recent graduate, to assist with environmental and qualification tests of storage batteries, including necessary design of tools and fixtures for tests; interpretation of military specifications for qualification and environmental tests. Must have ability to present ideas on mechanical-drawing form. Westchester County, N. Y. W-6473.

Assistant Engineer, pump manufacturer specializing in "built-to-order" centrifugal pumps for chemical and process industries. Excellent opportunity with good future. Salary commensurate with qualifications and experience. New England. W-6478.

Railway Mechanical Engineer, familiar with rolling stock and locomotives, together with shop practices related thereto; supervisory experience required. Work will involve railway-construction and transportation studies. Work will be for at least one year with strong possibility of permanency. Headquarters, New York; location, foreign. F-6480.

Machine Designers, at least five years' experience in the design of machine tools. Work involves making of design layouts of mechanisms and cutting-tool units preparatory to the development of detail drawings for production purposes. Need not be graduate engineers but good background of technical education and experience with machine tools is required. Pa. W-6489.

Production Planning and Control Manager, IE or ME graduate, planning and production experience including requisition analysis, inventory and production controls, packaging, and warehousing in food, drug, or cosmetic fields. $8000-$10,000. New York metropolitan area. W-6490.

Industrial Engineer, five years' experience covering job analysis, salary, and wage administration in commercial or banking fields. Spanish essential. $9000. Duration, six months. Caribbean area. F-6492.

Sales Engineers, Instrument-Sales Division, graduate electrical or mechanical, preferably married, three years' direct engineering experience closely related to airborne-equipment design, telemetering, or instrumentation design; two years of directly related sales experience. Six-month training program on West Coast. From $9000 to $12,000, to start, depending upon experience; fringe benefits; expenses. Company may negotiate placement fee. Territory, N. J., New York metropolitan area, and possibly L. I. W-6493.

Administrative Assistant to Vice-President, Marketing, power-tool manufacturer; graduate mechanical engineer and/or business administration; at least five years' administrative experience in a sales organization handling industrial-type products. Strong background in advertising, sales promotion, sales training, and market research and development. Will be required to administer advertising and public-relations programs; develop and administer sales-promotion program including catalogs, sales literature, price sheets, etc. $10,000-$14,000, plus generous fringe benefits, plus possible bonus. Ohio. W-6497.

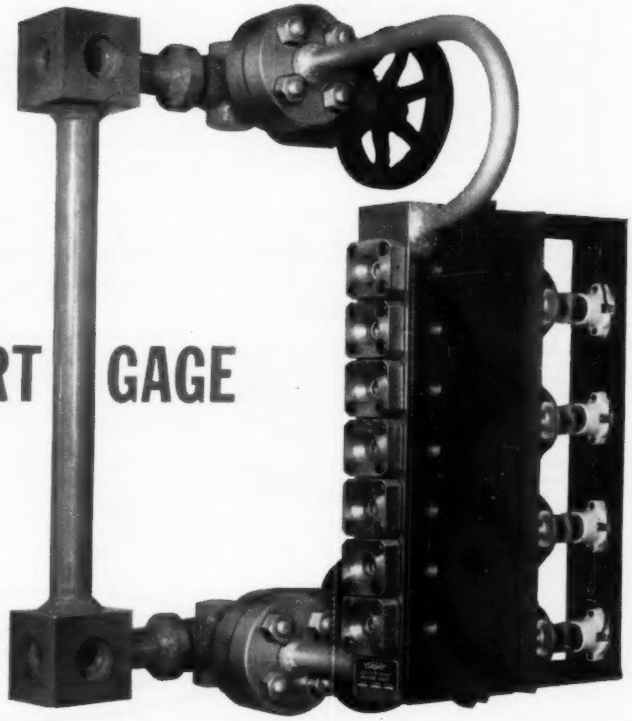
Transducer Sales Engineer, leading instrument manufacturer; graduate mechanical, electrical, or aeronautical engineer, at least four years' pertinent experience in flight test, project engineering, or associated fields. Should have experience and ability to apply and sell transducers for pressure, acceleration, temperature, and gyros. Top salary plus expenses, plus incentive. Headquarters, New York, N. Y. W-6500.

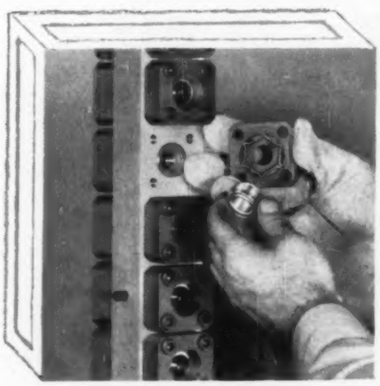
Design Engineer, research and development, engineering degree, two to five years' experience in the design of intricate automatic machinery. Must have ability to carry out complete and thorough design and development investigations, independent of existing designs. Some background in manufacturing applications as well as knowledge of the electromechanical application helpful. $7000-$8000. Western N. Y. State. W-6507.

Engineers. (*a*) Production-specifications engineer, degree in mechanical or metallurgical engineering, eight to ten years' experience in solving production problems in foundry, rolling, swaging, forging, and sheet-metal fabrication. Must be strong in the preparation of manufacturing specifications and the determination of types of inspection and procedures to insure a high-quality product. Salary open. (*b*) Production-equipment design engineer, graduate mechanical, eight to ten years' experience in foundry, rolling,

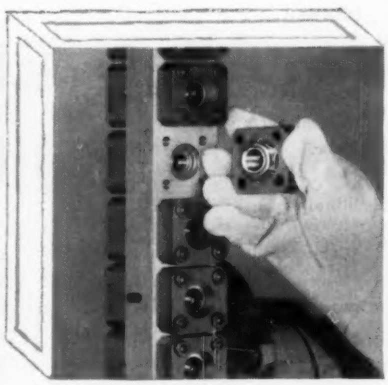
(*ASME News continued on page 144*)

servicing the new YARWAY COLOR-PORT GAGE is easy as a b c

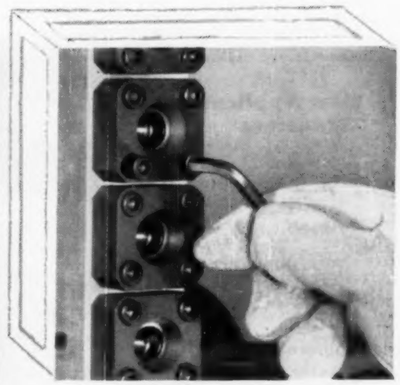




a Remove four cap screws and lift off cover assembly (held in right hand). Install new port assembly (glass-mica-gasket, shown in left hand) in cover. This port assembly is part of the complete cover assembly.



b Re-install complete cover assembly. Sealing gasket automatically seats in gasket groove in body.



c Tighten down four Allen cap screws with standard wrench (no torque wrench required).

New Yarway Color-Port Boiler Water Level Gages (for pressures to 3000 psi.) offer not only this new ease of maintenance but insure brilliant red and green readings of steam and water.

For full details, write for Yarway Bulletin WG-1814.

YARNALL-WARING COMPANY, 108 Mermaid Ave., Philadelphia 18, Pa.
Branch Offices in Principal Cities

GO YARWAY WITH CONFIDENCE

swaging, forging, and sheet-metal fabrication, to design and specify equipment to be used to perform a particular job at the lowest cost, including tools, dies, etc. Salary open. (c) Quality-control engineer, graduate metallurgical or mechanical engineer, courses in industrial management and manufacturing processes; special training in statistics, quality control, and analysis of data. Three to five years in shop trouble shooting, methods work, process engineering and quality control; to make economic studies of losses, set-up to collect inspection data for identifying sources of defects, etc. Salary open. New York metropolitan area. W-6508.

Design Engineer, graduate mechanical, reasonable amount of creative ability and general knowledge of machine shop and sheet-metal shop products. Must have previous experience in sheet-metal fabricating and casting design work. Company manufactures combustion, heating, ventilating, fans, blower exhausts, unit heaters, etc. Must have proved record of mechanical-engineering design work. To $9000. Northern N. J. W-6512.

Sales Engineers, 2, at least five years' equipment-sales experience including export business covering valves, expansion joints, pipe fittings, or allied power and process accessories for manufacturers' agent. Territories: One for Philadelphia, Pa., $10,000-$12,000, plus bonus; one for New York, N. Y., $8000-$10,000. W-6518.

Product Designer, mechanical or electrical graduate, at least five years' design, development and product-engineering experience on power-driven portable tools. $10,000. Pa. W-6519.

Plant Superintendent, graduate engineer or from a printing-management school, for a general commercial printing firm. Some experience in the printing industry desirable. Primary function will be staff and line responsibilities in conjunction with management of shop. Interested in management potential rather than broad experience. $6000-$9000. New England. W-6525.

Production Engineers, 2, for mechanical departments of a mechanical contractor. Graduate mechanical engineer with supplementary training in heating, ventilating, air conditioning, and plumbing. Six years' experience in work involving the mechanical trades. Prefer both design and installation experience such as two to four years with a mechanical-design organization dealing with large commercial installations and two to four years with a mechanical contractor as a field or project engineer. Will be responsible for production engineering of work in progress. $10,000-$12,000. One for Pa.; one for Ohio. W-6526.

Product-Design Engineer, mechanical graduate, to head up product-design section, primarily the design of industrial rotary positive displacement pumps, fluid motors, and accessory equipment. Position will lead to that of assistant chief engineer for a manufacturer. $10,000. Employer will negotiate placement fee. Chicago, Ill. C-6995.

Research, Development, Production, Missiles Systems, graduate engineer, science, mathematics, physics, chemistry; well-qualified by academic and working experience to fit into research and development laboratory or into project organizational divisions on military contract work—controls, guidance, propulsion, data reduction; seeking high-level candidates for established missiles and satellite investigations, development, manufacture, and test. Salary commensurate with capabilities. San Francisco Peninsula. S-3732.

Mechanical Engineer, Machine Design, preferably BS, ten years' experience designing fairly heavy material-handling machinery with electric-motor driving gears, controls; will head department designing gantry cranes for specially built plate handlers. $9000, and up. San Francisco East Bay. S-3793.

Sales Engineer, Mechanical, four years' experience selling to builders and users of large engines, compressors, turbines, and machinery; know oil filtering and oiling systems. Travel 60 per cent to 70 per cent selling liquid filters, strainers, etc.; car required. $600 or more a month depending on experience. Employer will negotiate fee. Headquarters, northern suburb of Chicago. C-6998.

Chief Engineer, Portable Compressors, BSME; ten years' experience; must have actual experience in the development and design of portable compressors, know all types of compressors. Duties will include management of portable compressor, design-engineering department; considerable field work with sales and service departments, personnel, budget, and scheduling responsibility. Responsible for design supervision of engineers and draftsmen doing research and development work related to gas and air compressors for a manufacturer of heavy equipment. $10,000-$15,000. Employer will pay placement fee. Northern Ind. C-7001.

CANDIDATES FOR MEMBERSHIP AND TRANSFER IN ASME

The application of each of the candidates listed below is to be voted on after Oct. 24, 1958, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and •Transfers

Alabama

Brumby, Arnoldus S., Mobile
•Willoughby, Harvey D., Birmingham

Arizona

Patterson, Harvey G., Scottsdale
Young, Roy W., Phoenix

Arkansas

•Cooper, Gordon M., North Little Rock

California

Alexander, Myron E., Campbell
•Bevans, Jerry T., Berkeley
•Bevis, John H., San Francisco
•Choti, Steven I., Buena Park
Dynes, Ruth E., Beverly Hills
Esten, Harold, Reseda
Frazier, Robert E., Bakersfield
•Gearhart, Donald A., Canoga Park
Hatch, Marian M., Beverly Hills
•Kenney, James T., Pasadena
•Manser, Paul K., Napa
McComb, John H., San Francisco
McGregor, William J., San Francisco
Peterson, Richard G., San Francisco
Stichka, James B., Richmond
Treece, Winston W., Los Angeles

Colorado

Higgins, Edward J., Denver

Connecticut

Cooper, William J., New Haven
•Eschenbrenner, Gunther P., Byram
•Rogers, Henry M., Jr., Gales Ferry
Thompson, Edward J., Naugatuck
Venus, Frank, Jr., Seymour

Delaware

Baer, Eric, Wilmington
•Young, Harlan S., Wilmington

• Transfer to Member or Affiliate.

District of Columbia

•Felbeck, David K., Washington

Florida

Bell, Everett G., Pensacola
Helsper, Robert G., Cocoa Beach
Hull, William T., Jr., Pensacola
Peterson, James M., Pensacola
•Pickens, Andrew L., Foley

Hawaii

Baxter, Norman G., Honolulu
Cotner, Jack A., Honolulu
Teel, Dale, Honolulu

Illinois

•Bafaro, Michael E., La Grange
•Ely, Allen J., Jr., Chicago
•Grumstrup, Glen I., Chicago
Harke, Raymond J., Chicago
•Nothmann, Gerhard A., Chicago
Raczek, Joseph D., Oak Lawn
•Wallace, William D., Chicago

Indiana

Connaughton, James F., Mishawaka
•Roesel, Thomas L., Hammond

Kansas

Fundenberger, David G., Shawnee

Maryland

•Lashley, Richard S., Hagerstown
•Shaver, Eugene L., Baltimore

Massachusetts

Allen, Earle F., Norwell
•Black, Robert J., W. Springfield
Geany, John J., Boston
Moule, Rex E., Holden
Oster, Arthur J., Brookline
Peterson, Robert C., Brighton

Michigan

Alvord, Herbert H., Ann Arbor
•Boria, Demeter M., Grosse Pointe
Jakubowski, Marek, Kalamazoo
Meulendyk, John W., Kalamazoo
Petti, Omer A., Detroit
•Witty, James C., Holland

Minnesota

Einfeldt, Robert B., St. Paul
Holberg, Donald L., St. Paul
•Howard, Melvin A., Rochester
Norris, John D., Minneapolis

Missouri

•Calkins, Robert G., St. Louis
•Doerr, Raymond E., St. Louis
Frohwerk, Paul A., Kansas City
Luke, Yudell L., Kansas City

New Jersey

Antonucci, Henry V., Union City
Otterbein, Mark E., Harrison
Stahl, Harold A., Phillipsburg

New York

•Aref, Mohamed N.E., New York
Baschkin, Bernard B., Mt. Vernon
Best, Theodore R., Jr., New York
Clark, Roger W., Scotia
Gottlieb, George, New York
Krim, Michael H., New Rochelle
Maclin, Ernest, Astoria, L.I.
Madonia, Ronald V., Baldwin
McHugh, Edward L., Port Chester
•Rosenberg, George E., Wellsville
•Saliano, Albert, Flushing
•Sear, Eric F., New York
Shade, Joseph J., Middle Village
Sylvan, Seymour, Brooklyn
Vance, Harold C., Jr., New York
•Voisinet, Howard E., Buffalo
Wallace, Robert B., Herkimer
•Westbrock, Adrian J., Tonawanda

Ohio

D'Isa, Frank A., Youngstown
Dittman, Billy F., Willoughby
Gleeson, William S., Cleveland
•Drosse, John W., Marshallville
Lampe, Robert F., Cincinnati
•Lund, Richard I., Cuyahoga Falls
•Segna, Joseph E., Columbus
Wahrenberger, Arthur G., South Euclid
•Zilliacus, Patrick W., New Philadelphia

Oregon

•Davidson, John H., Portland
•Smith, Paul B., Portland

Pennsylvania

Bahar, Leon Y., Bethlehem
Black, Frank E., Pittsburgh
•Daniels, Robert L., Scranton
•Greenberg, William B., Wynnewood
Jesch, Leslie F., Philadelphia
•Kerr, Wilmer A., Coraopolis
Walters, Robert M., Philadelphia

South Carolina

Crawford, William L., Jr., Aiken
Miller, John W., Aiken

(ASME News continued on page 146)

●Ticktin, Boyd L., Rock Hill

Tennessee

●Cissna, Charles D., Chattanooga
Roberts, James C., Jr., Chattanooga
●Wantland, John L., Oak Ridge

Texas

●Chapman, Alan J., Houston
●Compton, Joe E., Houston
Herring, Eugene W., Houston
Kisling, James W., Houston
Mitchell, Gene A., Dallas
●Pofahl, Thomas H., El Paso
Saunders, Jay S., Dallas
●Shall, David L., Baytown
●White, George W., Houston

Virginia

Dancy, Julian H., Richmond

Washington

●Dean, Roy D., Seattle

West Virginia

●Butcher, James M., South Charleston
Robinson, Donald D., Charleston

Wisconsin

●Hess, Paul D., Brookfield
Schulz, Robert E., Milwaukee

Foreign

Allen, James H., Newport, Victoria, Australia
Demeter, Gabriel A., Tel Aviv, Israel
●Gomez-Ojeda, Jose, Mexico, D.F., Mexico
Iqbal, Muhammad, Karachi, W. Pakistan
Kuhfeldt, Robert G., Barrancabermeja, Colombia, S. A.
●Perez, Rodolfo E. P., Nacozari, Sonora, Mexico
Sipp, George F., Salihli, Turkey

OBITUARIES

James Theodore Dillon (1923–1958), engineer, rate and operations group, Black and Veatch, Kansas City, Mo., died April 24, 1958. Born, Philadelphia, Pa., Nov. 27, 1923. Son of Theodore F. Dillon. Education, BS(ME), University of Pennsylvania, 1947. Mr Dillon previously had been a sales engineer with Ingersoll-Rand Co., New York, N. Y.

John Mitchell Drabelle (1886–1958), consulting engineer and retired chief engineer, Iowa Electric Light and Power Co., Cedar Rapids, Iowa, died June 7, 1958. Born, Des Moines, Iowa, Dec. 10, 1886. Parents, Meiggs J. and Caroline (Mitchell Drabelle. Education, BS(EE), Purdue University, 1915; ME, 1922. Married Ruth Groves, 1925. Mem. ASME, 1919; Fellow ASME, 1949. Mr. Drabelle had been a specialist in power-station operation, design, and maintenance. He retired from Iowa Electric Light and Power Co. in 1952 after 42 years of service. Since then he had been a consultant for Allis-Chalmers on foreign power-station design and installation. He held patents for an automatic hydroelectric station control system and automatic diesel-engine generating plant systems. He was the author of numerous articles published in *Power, Power Plant Engineering*, and the like. Mr. Drabelle had been chairman of a number of committees in the following groups: Mines and Mining in Iowa, Iowa Civilian Defense, Iowa Board of Railroad Commissioners, and the Iowa State Commerce Commission. He was a past-president of the Iowa Coal Institute, the Mid-West Gas Association, and the Iowa Public Utilities Association. In 1950 the Iowa Engineering Society presented the Anson Marsten award to him for distinguished service to Iowa and the society. He was a fellow of AIEE, and a member of the American Gas Association, the Edison Electric Institute, the National Association of Power Engineers, and Pi Tau Sigma. Survived by his widow; and a son, John M., Jr.

Alonzo Flack (1885–1958), a financial partner, Emerson Engineers, management counselors, New York, N. Y., died July 1, 1958. Born, Claverack, N. Y., June 27, 1885. Parents, Arthur Harold and Roberta Emmet (Andrews) Flack. Education, BS(ME), Syracuse University 1908. Married Agnes Bashford, 1919 (deceased). Assoc-Mem. ASME, 1915; Mem. ASME, 1935. Mr. Flack joined the Emerson firm fifty years ago as a junior management engineer and was operating manager before becoming a financial partner. As a management counselor he served as chief engineer for companies in the United States and foreign countries. They included the King Sewing Machine Co., the Bethlehem Steel Co., the Aluminum Company of America, Federal Glass Co., National Cash Register Co., the Standard Oil Co. of New Jersey, and the Graham Paige Motors Co. In World War I he supervised and managed plants manufacturing shells and other war materials. During World War II he was a consulting engineer to the British American Oil Co. and Gulf Oil Corp. Mr. Flack was the author of various short papers on management engineering subjects. He had been an active member in the Industrial Management Society, the Association of Consulting Management Engineers, SAM, and AOA. He served the ASME as a member of the Executive Committee of the Management Division, 1920–1924. As a honorary vice-president he attended the Eighth International Management Congress. He was a registered professional engineer in the State of New York. He was a member of Tau Beta Pi. Survived by a sister, Mrs. Stuart L. Peebles, Syracuse, N. Y.

Frederick William Greene (1890–1958), engineering consultant, Holyoke, Mass., died June 5, 1958. Born, Oxford, Mass., July, 1890. Parents, Welford and Ellen (Plouffe) Greene. Education, attended Northeastern University. Married Aurora Alsten, 1914. Assoc-Mem. ASME, 1922; Mem. ASME, 1945. Before entering his own consulting practice, Mr. Greene has been general manager, Pay and Scott Co., Dexter, Maine; and chief engineer, Walsh Holyoke Steam Boiler Works, Holyoke, Mass. Survived by his widow; two sons, Frederick, W., Jr., and Delbert; and two daughters, Mrs. Marjorie Seavey and Mrs. Dorothy Crouse.

Edward H. Hansen (1890–1958), book-manufacturing director, The Crowell-Collier Publishing Co., New York, N. Y., died Feb. 20, 1958. Born Gloucester, Mass., Sept. 20, 1890. Parents, H. Peter and Louise C. (Larsen) Hansen. Education, high-school graduate. Married Audrey A. Slade, 1909. Mem. ASME, 1936. Mr. Hansen had been with Crowell-Collier since 1937. He was the author of a number of articles, reports dealing with business cycles, and technical papers present before ASME and Taylor Society. He also directed classes in management engineering and had been a co-operative lecturer at Massachusetts Institute of Technology, and Brown and Boston Universities for many years. Survived by his widow.

Martin J. Kermer (1877–1958), retired chief engineer, Blaw-Knox Co., died in Venice, Fla., June 13, 1958. Born, Amsterdam, Holland, Dec. 18, 1875. Parents, George Leo and Elizabeth (Janson) Kermer. Education, ME, Amsterdam Technical School, 1900. Naturalized U. S. citizen, Chicago, Ill., 1912. Married Edith B. Boyd, 1907 (died 1940); one son, Martin J. Kermer. Married 2nd, Mary Hoffman, 1942. Mem. ASME, 1914. Mr. Kermer held 12 patents for evaporators, driers, and methods of heat transfer. He was a member also of AIChE. Survived by his widow.

John Harold Kincaid (1894–1958), chief engineer and assistant vice-president, Wellman Engineering Co., Cleveland, Ohio, died June 25, 1958. Born, Cleveland, Ohio, July 28, 1894. Education, studied mechanical engineering, Case School of Applied Science, 1914–1916. Mem. ASME, 1946. Mr. Kincaid had spent his entire professional career with Wellman Engineering. He is credited with design and development of much of the company's bulk materials and ship loading and unloading machinery. He was a member also of the American Iron and Steel Institute and the American Welding Society. Survived by his widow, Ida M. Kincaid; a daughter, Mrs. Dorothy M. Pallet; two sons, Donald and Charles Kincaid; and 11 grandchildren.

Walter John Maytham (1872–1958), retired chief engineer, Northwestern States Portland Cement Co., Mason City, Iowa, died June 17, 1958. Born, Buffalo, N. Y., Oct. 17, 1872. Parents, Thomas and Elizabeth (Green) Maytham. Education, ME, Cornell University, 1902; studied civil engineering, University of Michigan and University of Wisconsin; and ICS. Married 2nd, Nova Buntin, 1937. Mem. ASME, 1905. Mr. Maytham was a specialist in the design and operation of cement-manufacturing plants. He designed all or part of at least 16 such plants in the United States and Canada. Survived by his widow and four children from a previous marriage: Mrs. Thomas Melville, Walter John, Jr., Mrs. Leo J. Mueller, and Mrs. Clifford Holland.

Roy Carnegie McKenna (1883–1958), chairman of the board, Vanadium Alloys Steel Co., Latrobe, Pa., died July 13, 1958. Born, Pittsburgh, Pa., March 7, 1883. Parents, Thomas and Anna (Hogan) McKenna. Education, EE, University of Pittsburgh, 1903; LLD, St. Vincent College; LLD, University of Pittsburgh. Married Mary E. Martin, 1906; daughter, Jean M. McKenna (Mrs. C. H. Sorber). Mr. McKenna had been president of Vanadium Alloys Steel Co. since 1915. An advocate of profit-sharing systems, Mr. McKenna was active in numerous civic, professional, and charitable organizations. He was a trustee of the University of Pittsburgh, president of the Latrobe Library Association, and director of Latrobe Hospital. Mem. ASME, 1918. He was a member also of the Engineering Society of Western Pennsylvania and American Society for Metals.

George Edward Mugrauer (1930–1958), sales engineer, Ignersoll-Rand Co., Wilmington, Del., died June 6, 1958. Born, Philadelphia, Pa., March 30, 1930. Education, BS(ME), Drexel Institute, 1957. Assoc. Mem. ASME, 1957.

Fred William Schlichter (1906–1958), president, The Hamilton Tool Co., Hamilton, Ohio, died July 4, 1958. Born, Hamilton, Ohio, April 27, 1906. Education, high-school graduate and Ohio Mechanics Institute. Mr. Schlichter was secretary of the tool company from 1927, when it was organized, until 1938, when he became president. He was a member of the board of Ft. Hamilton Hospital and chairman of the hospital's expansion committee. He also was a member of the American Management Association. Survived by his widow, Mrs. Bernice Schlichter; a son, Wayne; a daughter, Mrs. John Cochran; his mother, Mrs. Katherine Schlichter; and two brothers, three sisters, and five grandchildren.

Francis Henry Vanaman (1889–1958), mechanical engineer, Methods and Equipment Division, The Budd Co., Philadelphia, Pa., died June 13, 1958. Born, Philadelphia, Pa., Oct. 10, 1889. Parents, Frank Lee and Emma L. (Snyder) Vanaman. Education, attended Drexel Institute. Married Marie Ferguson Wenrick. Assoc-Mem. ASME, 1929; Mem. ASME, 1935. Survived by his widow.

Edward Pearson Warner (1894–1958), retired president, council of International Civil Aviation Organization, a United Nations agency, Montreal, P.Q., Canada, died July 11, 1958. Born, Pittsburgh, Pa., Nov. 9, 1894. Parents, Robert Lyon and Anne (Pearson) Warner. Education, BA, Harvard University, 1916; BS, Massachusetts Institute of Technology, 1917; MS, 1919; hon. DS, Norwich University, 1938. Married Joan Potter, 1931. Jun. ASME, 1917; Assoc-Mem. ASME, 1925; Mem. ASME, 1928. Mr. Warner was the first chief of ICAO when it was established as a provisional body in 1945. His life-long association with aviation began in 1910 when he built a glider and following year flew it in an intercollegiate competition, taking first prize for efficiency. His career in aeronautics began as an instructor of aeronautical engineering at M.I.T. in 1917. Here, during World War I, he gave Army and Navy air units intensive training in aeronautical engineering and conducted wind-tunnel tests. Following the war, he was chief physicist of the National Advisory Committee for Aeronautics in charge of research at its Langley Field Station. In 1920 he served in Europe as technical air attaché for NACA. He returned to M.I.T. in 1920; was associate professor of aeronautical engineering until 1924; and professor until 1926. In 1929, he became the first Assistant Secretary of the Navy for Aeronautics. He resigned that post in 1929 to become editor of *Aviation* for five years, the last year of which was spent as assistant to the president of the McGraw-Hill Publishing Co. A consulting practice occupied him from 1935 to 1938. In 1938 he lectured at Norwich University. He became a member of the Civil Aeronautics Authority in 1939, serving on it and its successor, the CAB, until 1945; he was its chairman in 1941 and again from 1943 to 1945. His service with the CAB was broken by several trips to England with W. Averill Harriman's staff for the expediting of lend-lease operations. Mr. Warner was the author of books: "Aerostatics" (1926) and "Aeroplane Design—Aerodynamics" (1927). The latter was awarded a medal by the Aero Club of France. He also contributed many papers on scientific, industrial, political, and educational subjects; as well as the "Aviation Handbook" with S. Paul Johnston. He was one of the founders of the Institute of the Aeronautical Sciences and participated in early activities of the ASME Aeronautics Division. Mr. Warner had been honored by many groups. In 1932 SAE presented him with the Wright Medal. He was the 1949 recipient of the Daniel Guggenheim Medal. In 1943 he delivered the Wilbur Wright Lecture before the Royal Aeronautical Society and was made an honorary fellow of the RAS. He was an honorary fellow also of the AAAS and IAS. He had been active in SAE serving as its vice-president, 1929; and president, 1930. He was president also of the American Bureau of Aircraft in 1930. Survived by his widow; a son, Barry Warner; a daughter, Sandra Warner; and a brother, Dr. Nathaniel Warner.

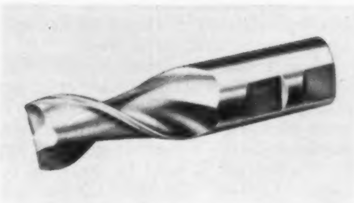

This is a direct descendant of the first continuously adjustable autotransformer, commercially developed and manufactured by General Radio Company in 1933.
Carefully designed, conservatively rated, and painstakingly manufactured, with Duratrak brush-contact surface ...
this* is the 1,000,000th Variac®
115V.-6A-50-60 CYCLES
FOR COMMON (GRD.) LINE LOAD CONNECTION USE TERMINAL 2 OR 4
GENERAL RADIO COMPANY
CAMBRIDGE, MASS. U.S.A.
TYPE W5
VARIAC®
PAT. APPLIED FOR
* Additional thousands of special VARIACS have been designed for unusual applications

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Available literature or information may be secured by using convenient Reader Service Card on page 163

NEW EQUIPMENT



End Mills

Thirty-nine new high speed steel end mills have been added to the more than 3300 cutters that make up the standard products of Cutting Tool Div., Brown & Sharpe Mfg. Co.

The cutters are designed for milling aluminum and aluminum alloys. Generous chip clearance and use of a special abrasion resistant high speed steel improves performance and greatly adds to tool life. Other features include a 40 deg helix and 20 deg rake, a combination designed for a shearing cut of maximum efficiency on aluminum. A completely ground finish over entire mill surface with ground eccentric relief of sharp precision cutting edge adds to production performance.

These new end mills are available in 3 different lengths, Standard, Long and Extra Long in sizes $^1/_4$ to 2 in. diam. **—K-1**

Vibration Testing System

A compact new sine wave vibration testing system, the Sine-O-Matic Model CP-3/4, has been announced by Ling Electronics, Inc.

A completely packaged testing system, the unit features fully automatic programming and operation. All components, including power generator, field and degaussing supply, cycling oscillator, servo system, automatic power factor corrector, and start-stop controls, are mounted in a streamlined desk-type console. Only the shaker is external.

The system provides a peak sine wave vector of 1200 force-pounds, when used with a Model C10 shaker and will drive a C25H or C25B shaker to reduced force. Power output is 3000 w. The system supplies its full rated force output over the entire frequency range of 5 to 3000 cps without impedance changing. **—K-2**

Titanium Alloys

Crucible Steel Co. of America announces availability of three new heat-treatable titanium alloys, one of which is said to be the first heat-treatable all-Beta titanium alloy to be produced.

The three alloys have the unique advantage of being capable of being readily formed in the so-called solution treated or "soft" condition and then strengthened by simple thermal aging treatments, the company states.

The strengths obtainable with each of these alloys are higher than previously possible in titanium sheet materials.

The new Beta alloy, B 120 VCA is said to represent a major technological breakthrough for the titanium industry. **—K-3**

Air Bleed-Off Valve

A new valve, designed and built by Denison Engineering Div., American Brake Shoe Co., automatically eliminates air in hydraulic circuits. The new valve operates in hydraulic circuits under pressures up to 5000 psi.

Presence of air in a hydraulic circuit can prevent the pump from priming when it is connected with a closed center valve or with another pump, possibly causing extensive damage to internal parts. The valve automatically vents air to tank, assuring adequate pump priming and efficient circuit operation.

Dimensions of this valve are $2^3/_8$ by 1 in. hex. Available with $^1/_4$ NPT or $^9/_{16}$ in.-18, straight threads.

The new automatic air bleed-off valve is installed in the pump discharge line—ahead of all other components—with a T connection.

The valve remains open as long as system pressures remain low—and permits air to flow to tank. When air has been dissipated, the initial surge of hydraulic fluid automatically closes the valve, which remains closed until the pressure drops. **—K-4**

Hand Tachometer

A single-range precision hand tachometer, said to be ideal for accurate speed measurements in laboratories, test beds, and in quality control or production tests, has been announced by James B. Biddle Co.

The dial diameter is 120 mm (4.7 in.), and the scale calibration is open and easily readable. The 7 mm (0.27 in.) drive shaft is equipped with ball bearings. The Jagabi precision hand tachometer is supplied with two large rubber mounted male and female centers, an extensive shaft and center, oil container and dropper, and is in a strong case $9^1/_2 \times 6^1/_4 \times 3$ in. Total weight is $3^1/_4$ lb. **—K-5**

Electronic Control

A full series of completely solid state electronic control instruments has been introduced by Foxboro Co.

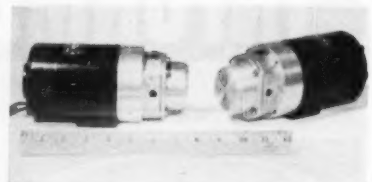
The new line, called electronic Consotrol instrumentation, consists of advanced design transmitters, recorders, controllers, and valve operators, covering every function in the process control loop. Typical process measurements such as pressure, flow, and level, are converted at the transmitters to proportional current signals and instantaneously transmitted over unshielded lines to a control center.

Converters for EMF and resistance measurements also feed signals to the small case, panel-mounted receivers. In the same electrical range are the controllers and final operators which complete the loop.

Features of the instrumentation, in addition to the use of magnetic amplifiers and transistors, are choice of motion balance or force balance transmitters; electrical measurement converters, entirely tubeless and mounted for front-of-panel accessibility; new control station design; and diversified installation arrangements using standard system components. **—K-6**

KEEP INFORMED

BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS



Pump-Motor

A new custom engineered pump and motor combination, recently developed by the Tuthill Pump Co. is designed to operate from a conventional 12 v battery. The new unit was originally developed for hydraulic applications on small mobile hoists.

The new unit incorporates a specially designed motor into a rotary-gear pump, producing a combination unit which takes up no more space and weighs no more than a conventional electric motor. It measures $3^3/_{16} \times 7^5/_{16}$ in., and is rated for 30 cu in. per minute at 500 psi. The motor has a rating of $^1/_8$ hp. The unit uses 10-W lubricating oil as a hydraulic fluid. Operating temperatures can be up to 200 F. **—K-7**

Fork Trucks

Two new Ranger fork trucks of 4000 and 6000 lb capacity, designed for high speed handling and tiering over sand, mud and rough terrain, have been introduced by Industrial Truck Div., Clark Equipment Co.

Suited for all-weather handling duties around building sites, orchards, lumber mills, and similar rugged locations, the units feature high lift speeds and bi-angular steering. Equipped with both two-wheel and four-wheel drive, the trucks have an oscillating rear axle which permits the machines to travel over rutted, bumpy ground and still maintain traction with all four wheels, the firm reports.

Front and rear wheel disconnect permits the units to be towed to job sites at highway speeds. A combination of standard Ackerman steering and wagon-wheel steer gives the unit a short turning radius in spite of its relatively long wheelbase. When the power-assisted steering wheel is turned the rear axle turns 28 deg and the rear wheels turn an additional 28 deg, giving a 56 deg turn. According to the company, this is the first use of such steering on a four-wheel drive machine. **—K-8**

Milling Attachment

A new milling attachment for mounting on lathes, milling machines, turret lathes, planers, boring mills, and as original equipment on special machines is announced by Alva Allen Industries.

The spindle is mounted on taper roller bearings and has No. 3 Morse taper for tool. Six different speeds, ranging from 200 to 900 rpm, are available. Spindle height (bottom of base to center line of spindle) is 2 in. and capacity is 1 in. end mill. **—K-9**

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Combination Bearing

A dual-duty cylindrical roller bearing, announced by Rollway Bearing Co., is designed for applications where both thrust and radial loads must be carried in a restricted space.

The unit consists of two roller assemblies, radial and thrust, with the flanged inner race of the radial section serving at the same time as the revolving plate of the thrust section. The outer race of the radial bearing is stationary with respect to inner race, and is completely separable, the company reports. A step in the bore of the bearing retainer serves as a means of locating the thrust roller assembly in the bore of the stationary thrust plate. The radial portion of the bearing is located on the shaft.

The bearing, designed for both continuous and intermittent operation, is available with bronze or Rollube retainer. **—K-10**

Gage Protector

A new gage protector with instant and precise shutoff to protect gages from overpressure for actuation from 5-2400 psi is offered by Circle Seal Products Co.

The company says the system provides in a single unit all characteristics necessary for protection of gages and operating personnel. The 1100 series valves overcome the O-ring breakaway friction problem characteristic of piston type units. Precise operation is insured even at very low settings due to the use of contact rather than sliding seals, the firm states.

Designed for gas systems, and available for liquid systems, the protectors automatically shut off instantly in the event of bourdon tube rupture.

Automatic gage cut-out and cut-in is provided. Snubbing action in gas systems where surge waves or shock waves are encountered closes the valve unit momentarily to reduce shock on gage elements. **—K-11**

Tractor Attachments

Introduction of several new attachments designed to extend the working efficiency and ease of operation of the D4 and D6 tractors has been announced by Caterpillar Tractor Co.

In-seat starting, which allows all engine starting operations to be performed from the operator's compartment, is a newly available attachment for the D4. This attachment may be ordered factory-installed on new machines, or may be installed on presently-operating machines having gasoline starting engines either manually or electrically started, the firm reports.

For both D4 and D6 tractors operating with front-mounted hydraulic equipment in atmospheric temperature over 100 F, a high ambient temperature radiator is available as an attachment. The new radiator is recommended for use only if overheating problems occur due to a combination of both of the above factors. **—K-12**

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Bulk Bin Level Control

A new Bin-Vue level indicator and control which features an easy-off cover and a fail safe device has been announced by Convair of Pittsburgh, Pa.

Access to the unit is gained by push-up, push-down and pull-off motion on the single-piece cover. The cover is held in place by compression of an O-ring on the mounting flange.

A limit switch, acting as a fail safe device, is activated 18 times a minute and can be connected for visible or audible control. This switch may also be connected to a relay circuit for automatic control. Failure of any part of the unit will alter the signal and stop or start other equipment it controls, the company states.

In operation, a $^1/_{100}$ hp motor turns a four blade paddle at 9 rpm by means of a torsion spring. The paddle turns continuously as long as no material touches it. When material makes firm contact with the paddle, the paddle stops. The motor continues to run, turning the spring until it activates a limit switch. The switch kicks off the motor and any other equipment connected to the indicator. When the material falls away from the paddle, the torsion spring reactivates the paddle and, in so doing, unwinds from the limit switch, starting the motor and putting the entire unit in operation again. **—K–13**

Jig, Fixture Buttons

A complete line of jig and fixture rest buttons made of alloy steel is offered by Jergens Tool Specialty Co.

Available in two types, the rest buttons are used as cutter set gage blocks and as locating parts in jigs and fixtures. They are manufactured in 16 sizes and have ample grinding stock left on shank for final fitting. Other rest buttons, with drilled and C-bored hole for socket head screw, are available in 18 sizes. Each special jig rest buttons complete with a socket head cap screw. **—K–14**

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Excess Air Gas Burner

A new excess air gas burner for sealed-in firing in industrial furnaces, kilns and other heat processing equipment has been developed by Hauck Mfg. Co. The burner produces an exceptionally stable flame even with 1000 per cent or more of excess air, the firm reports.

Because of the greater forward velocities of hot combustion gases, a better distribution, circulation, and penetration of heat is effected. Excellent control of flame temperature and dependable operation are obtained with either large or small amounts of excess air. Stratification of hot gases is minimized and development of localized hot spots is eliminated. Fewer burners are needed. Ignition is positive and easy at any burner setting on hot or cold furnaces. A continuous pilot is not required. There is no burner flashback. **—K-15**

Compacting Press

A more compact, fully-enclosed design with modern streamlined styling is the principal feature of a redesigned R series of 20-ton single-station single-pressure powder metal and ceramic compacting presses introduced by F. J. Stokes Corp.

Like the earlier design, the new presses can make tablets up to 3 in. diam and 2 in. depth of fill, at the rate of 16 to 48 pieces per minute, depending on the material being compacted. Tooling used on the earlier presses can also be used on the new series, and most working parts are interchangeable. **—K-16**

Small Motors

Barber-Colman Co. offers a new improved a-c motor design in the smallest of its motors.

The new Type A motor has substantially more and higher efficiency without increase in overall dimensions, the company says. The motor is being used where space and size are critical, and low noise, high torque, and long life are essential. Fan blades from 2 to 4 in. may be attached for use in deodorizers, electronic equipment and blowers. **—K-17**

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Miniature Gear Boxes

A new line of standard size eight miniature gear boxes has been put into production by Ellison Engineering Co.

The units will mate with any standard size 8 a-c or d-c motor, and can be adapted to any motor end configuration, the firm reports. Ratios from 1.5:1 to 600:1 are available. Weight of the units may be as little as $^3/_8$ oz with aluminum housing.

Stainless steel housings are available, and all gears are stainless. Using Class 5 miniature bearings throughout the units have backlash as low as 45 minutes, and will handle 50 in-oz of torque. Starting torque is .015 in-oz or less depending on the ratio required. Two output shaft diameters are available: .0937 and .1250; the shaft may be either concentric or offset with respect to the housing. **—K-18**

Silicone Rubber Compounds

Three new silicone rubber compounds designed for fabrication of O-rings, gaskets, and other seals have been added to the standard product line of the Silicone Products Dept., General Electric Co.

Designated SE-362, SE-372, and SE-382, these compounds readily meet or surpass the requirements of AMS 3303C, 3304B, and 3305C respectively.

Featuring tensile strengths of 1000 to 1200 psi and compression sets ranging from 17 to 19 per cent after standard cures, the new compounds offer far better physical properties than earlier Class 300 compounds, the company states. Tear strengths range from 65 to 75 lb-in. after an oven cure of four hr at 480 F.

Linear shrinkage during cure is less than 2 per cent. Because of their low compression set and good oil resistance, SE-362, SE-372, and SE-382 are especially suited for O-rings and other seals used in contact with petroleum oils and most hydraulic fluids, the company says.

ASTM requirements also met by these compounds are those of TA604 for SE-362, TA704 for SE-372, and TA805 for SE-382. **—K-19**

Synchronous Generators

Columbia Electric Mfg. Co. announces its new Frame 5200 series synchronous generators now available in 900 rpm ratings through 1250 kva, 0.8 pf, 1000 kw, three phase, 60 cycles (and equivalent 50 cycle ratings) in all standard voltages through 6600 v.

The new and larger frame, designed for ease of maintenance, has rigid bracket bearing construction, featuring ball bearings, integral lifting lugs, all welded steel dripproof construction, baffled ventilating system, full damper (amortisseur) winding, well insulated layer wound field coils, Class A or Class B insulation as specified, the company reports. **—K-20**

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Belt Conveyor

Hewitt-Robins, Inc. has developed a new type of belt conveyor featuring a hammock-style idler suspended on wire ropes which can be erected and taken down one-third to one-half faster than the conventional conveyor.

The firm claims the new unit operates with less spillage of material, prolongs belt life, and provides smoother, more economical operation. Except for the belt itself, the new conveyor is a marked departure from conventional conveyor design, the firm reports. It consists of prefabricated steel stands of uniform size and shape, held in alignment by parallel $^5/_8$-in. wire ropes on either side of the stands. This supporting structure replaces heavier rigid steel members. The wire ropes may also be suspended from the roof of a mine by means of special suspension frames anchored with roof bolts.

The belt travels on hinged idler rolls mounted in a new hammock-shaped frame. Heavy-duty hinges allow the individual rolls to move freely in a vertical plane so that off-center loading of the belt is automatically corrected without de-training the belt. The hammock frames also serve as spreaders to keep the ropes in their proper lateral position. The idler rolls are equipped with tapered roller bearings and multiple protection grease and dirt seals. **—K-21**

Electronic Tube

A storage tube, WL-7228, for use in radars has been developed by the Westinghouse Electric Corp., electronic tube div.

More than 100,000 pieces of information may be stored in the tube, the firm states. In a fraction of a second, information received by radar can be committed to the memory of this storage tube for long periods. When needed, the information can be displayed visibly on a flourescent screen long enough for the human observer to grasp.

The tube contains three electron guns. One gun receives and writes the information on the memory unit at a rate of over 200 miles per hour. A second gun wipes out the stored information, or any part of it, at will. The third gun enables the information to be brightly displayed on a screen. **—K-22**

Packaged Firing Units

National Airoil Burner Co., announces Series 20 steam atomizing packaged firing units for oil and/or gas fuels.

The units are fully automatic and have low fire start, electric-gas ignition, modulation fire control, damper sequence control, forced draft combustion air, electronic combustion safety supervision, mechanical atomizing, steam assisted internal mixing oil burner, ring or cylindrical type gas burner for gas fuel. **—K-23**

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Air Line Lubricator

A new automatic-fill air line lubricator, designed to eliminate maintenance and downtime associated with manual filling, has been introduced by Watts Regulator Co

The unit, called No. A606 Perma Fog lubricator, features a built-in float mechanism which automatically maintains a constant oil level in the lubricator bowl when fed by an oil supply line with pressure from 10 to 100 psi greater than the air pressure applied to the lubricator.

Minimum oil feed rate is said to be in excess of any possible lubricator demand. The new lubricator is available in $^1/_4$, $^3/_8$, $^1/_2$, $^3/_4$, and 1 in. sizes. **—K-24**

Shock Test Machine

A shock machine specifically designed for testing ballistic missile components yet said to be versatile enough for any type of shock testing, is announced by Lycoming Div., Avco Mfg. Corp.

The machine is said to be the nation's first shock machine specifically developed to meet the rigid specifications of the WS-107A-2 environmental test requirements–airborne electronic equipment.

According to the company, the machine can produce, and accurately reproduce, sawtooth-wave shock patterns of more than 100 g's over a shock response spectrum of 80 to more than 1000 cycles per second. It provides a specified terminal-peak sawtooth pulse shape rising to 100 g's in 6 milliseconds and then dropping abruptly to zero. It can also provide a variety of wave patterns including quarter-and half-sinc wave shocks.

From a pre-determined drop height, the carriage impacts against a molded lead pellet. By controlling the size and shape of these pellets, a wide variety of pulse forms can be obtained. The pellets themselves are uniformly produced by a simple molding process.

Precision operation is accomplished by pneumatically positioning the specimen carriage and releasing it for fall by a solenoid-operated release mechanism. This pellet is placed on the impact anvil set in the 2000 lb concrete base of the machine. Operator safety is insured by the built-in safety features of the simplified control panel, the firm says, and the anvil, carriage, and superstructure are seismically isolated from each other to prevent ringing.

The machine accomodates specimen weights up to 40 lb and a cross-sectional area up to $12^1/_2$ in. **—K-25**

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Drying Feeders

Heavy and extra-heavy duty electromagnetic feeders are now available with special direct-panel heated troughs from Syntron Co.

Addition of the new feature simultaneously affords effective rate-controlled feeding and efficient bulk materials in-transit drying, the firm reports.

Feeding movement is the result of 3600 electromagnetic, pitch-directed vibrations per minute, controlled through continuously variable degrees of power by the unit's separate controller.

Drying is accomplished by the rate-controlled movement of a layer of material over a cascaded series of electrically heated panels, loosely interlocked to act as louvres, allowing the introduction of forced air from a turboblower system through and across the cascading material to dissipate the vapor produced in the drying process.

The company states that the panels can be pivoted to adjust the slope to best suit the structural and flow characteristics of different materials. Heat intensity is thermostatically or percentage-timer regulated. **—K-26**

Packaged Drives

Cutler-Hammer Inc., has announced a new line of adjustable speed d-c packaged drives featuring static power conversion.

Ultraflex packaged drives, the firm's name for the new devices, utilize light, compact static power components to replace the conventional motor generator set. Conversion units eliminate all bearings, brushes, commutators, shafts, and couplings of rotary type d-c power sources, the company states.

Simplified circuitry in the conversion units make the drives as understandable and easy to install and maintain, as standard industrial control, the company says. The drives are available in two forms: Ultraflex E, a 1 to 40 hp electronic adjustable speed drive; and Ultraflex M, a 1 to 200 hp magnetic amplifier adjustable speed drive.

All drives include three basic components: the enclosed panel, housing the conversion and control units; an operator's station; and an industrial d-c motor. **—K-27**

Brushless A-C Generators

A line of 50, 60, and 400 cycle brushless alternating current generators has been developed by Kato Engineering Co.

The machines are available in both single and three phase output with all standard commercial voltages available throughout the range of sizes offered in brush type alternators. The 60 cycle, three-phase sizes extend from 5 to 400 kw and 400 cycle from 1 to 250 km revolving field types in all standard commercial voltages through 600 v. Some sizes are available in the higher voltages of 2300 or 4160 v. **—K-28**

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Forged Steel Couplings

Metal Products Div., Koppers Co., announces the availability of a newly-designed forged steel coupling, produced in sizes $5^1/_2$ and 6, said to be stronger and lighter than cast steel couplings used in most of the same applications. **—K-29**

Pipeline Strainer

A new line of semi-steel, self-cleaning pipeline strainers in sizes from $^1/_4$ through 3 in. has been announced by Sarco Co.

Features of the strainer, type AT, are the high strength construction of the semi-steel, ASTM-A48-48, class 30, bodies, internal design that insures tight fit of the screen cylinder without buckling, perforated heavy gage screen with spot welded lap seams that insure maximum rigidity with smooth inner surfaces, and built-in sediment collection chamber integral with cap. **—K-30**

Clutch-Brake

Stearns Electric Corp., announces the availability of a series of clutch-brake combinations, furnished as complete units with bearings, shaft, mounting stand. These units are in the style SMCB, Sizes 2, 3, and 5.

Both the clutch and brake are magnetically set, which includes a neutral position, and can be furnished with a common armature, splined to the driving shaft, or with a common hub with separate armatures for the clutch and brake, in order to key the hub to the shaft, allowing zero backlash.

Torque ranges of the units run from 25 in-oz to 175 in-lb on both the clutches and brakes. Both clutch and brake coils are set up for direct current operation and can be wound for any voltages up to and including 90 volts d-c. **—K-31**

High Pressure Pumps

Hydraulics Div., Webster Electric Co. announces production of eight low volume gear type hydraulic pumps specially designed for high pressure needs with low power consumption.

The company says the pumps have built-in relief and check valves to eliminate additional plumbing. The pump is about the size of a man's fist. All pumps have a 4-bolt mounting plate. The firm is offering them for special hydraulic lift applications as well as the electric lift truck field.

The pumps are available with either a tang drive shaft or keyed drive shaft. Capacities range from $^1/_2$ to 3.7 gpm. Pressures obtainable, according to capacity, are (at 1750 rpm): 1.35, 2.4, 3.0, and 3.7 gpm—up to 1500 psi; .5, .75, .9 and 1.2 gpm—up to 2000 psi.

The pumps can be operated at speeds up to 2600 rpm. The pressure relief valve can also be adjusted to requirements, the company reports. **—K-32**

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High Tensile Electrodes

Lincoln Electric Co., has announced two new electrodes for making high strength joints in alloy steels.

The electrodes, Jetweld LH-90 and LH-110, are new iron powder, low hydrogen types. LH-90 is classed E-9018 and also meets the requirements of E-8018-B2. LH-110 is classed E-11018. The low hydrogen coatings with iron powder added increase the deposit rates and improve operating characteristics, the firm reports.

LH-90 is intended for use on high temperature, high pressure piping, and on steel fabrication where either the particular alloy content or the high tensile strength is necessary.

LH-110 is intended for use on the new HY-80 and T-1 steels, as well as any other steels that require high strength joints. The deposits of both electrodes are said to have good impact properties in both the as-welded and stress-relieved conditions. —K-33

Extension Height Block

Development of an entirely new precision measuring device, an extension height block which permits both height and reach measurements in inspection, layout, and prototype operations, is announced by Machine Products Corp.

The new block makes it possible to move inspection equipment (height gage and indicator, for example) closer to the work piece, eliminates the need for excessive extension arm lengths, the firm reports. As a result, better control of measuring devices can be maintained, thus allowing measurements to closer tolerances and more accurate readings in highly inaccessible places. Additional application flexibility is provided by the fact that the block can easily be built up to any height requirement.

The block is a one-piece Meehanite casting constructed for long-lasting accuracy, yet light in weight for convenience in use. Standard overall height is 10 in., ± .0005. —K-34

Forged Globe Valve

A round bolted bonnet, bolted gland globe valve has been added to the Henry Vogt Machine Co. line of valves for 150–800 lb service. It is available with screw ends or socket weld ends in 1/4 through 2 in. sizes.

All valves have forged steel bodies with integral seats hard faced with Stellite or equal. Disks are 13 per cent chrome stainless steel, and other trims are available. Yoke nuts are of special high melting point alloy material, the firm reports.

Stuffing boxes are said to be extra deep for longer life of packing and they have one-piece, forged steel packing glands. Packing gland studs and nuts are stainless steel. Gaskets are stainless steel, spiral wound, asbestos filled. —K-35

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Centrifugal Pumps

A new line of heavy duty centrifugal pumps for refinery and process service has been announced by Dean Brothers Pumps Inc.

Designed as Series R-200, the new line incorporates API and major oil company specifications together with maximum interchangeability of parts. Capacities range from 25 to 1000 gpm with total heads to 650 ft in a pumping temperature range from −150 to +850 F.

The stuffing box in Series R-200 is designed to accomodate either a mechanical seal or packing, interchangeably, without any modification of pump. **—K-36**

Bellows Expansion Joint

Skinner Seal Div., Hydrodyne Corp., announces the production and availability of a machined bellows expansion joint.

The new product, which may be made of a variety of metal alloys, and in a wide range of sizes, utilizes the firm's spring seal, machined on each end to permit high pressures and extreme high and low temperatures—the latter to −320 F.

According to the firm, this joint of controlled wall thicknesses has an unusually long fatigue life. This joint, which may be of stock tubes or machine stock, is an improvement over other drawn materials. The product has applications in fuel systems, both liquid and oxidizer lines, for LOX missiles. **—K-37**

Remote Control Valves

A new line of Speed King 1/4 in. four-way foot mounted remote-operated control valves, said to be well suited for use in hazardous locations and wherever remote pilot operation is desired on any pneumatically-interlocked circuitry, is announced by Valvair Corp.

Reputed to afford compact size, fast operating response and multimillion cycle dependability at low cost, the new valves are offered both in single and double types. Valves can be controlled electrically through the use of solenoid pilots installed any distance from the valve, or pneumatically by any manually or mechanically-actuated manual valve.

Valve bodies are Navy M bronze, stem is hard-chrome plated stainless steel, with firm's standard O-ring packers. **—K-38**

Specialty Steel

Engineered to tool and die shop requirements is a new flat ground oil hardening tool steel ground .014–.016 oversize on thickness dimension, announced by Latrobe Steel Co.

The steel, designated Badger, is an 01 type tool steel, with a tungsten and higher chromium content to give it improved wear resistance over straight manganese types. **—K-39**

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Mild Steel Electrode

Lincoln Electric Co. has announced a new E-6012 electrode with an electrode coating that includes the addition of iron powder.

The firm says the new design makes the electrode easier to operate and faster than previous E-6012 designs. The electrode, Fleetweld 7MP, is classed as an all-position, a-c and d-c, mild steel electrode.

The inclusion of a moderate amount of iron powder and certain arc stabilizing ingredients to the coating produces an electrode said to combine the ease of operation, good bead appearance and a-c operation of an E-6013 electrode with the higher speeds and lower cost of an E-6012 electrode. The electrode is available in the $^1/_8$, $^5/_{32}$, and $^3/_{16}$ in. sizes.

—K-40

Acid Resistant Chains

Two new chains, X-weld acid pickle and X-weld Type 321 stainless steel, have been developed and designed for high temperature applications and in solutions of sulphuric or nitric acids in industrial pickling operations. They are manufactured by American Chain Div., American Chain & Cable Co.

The acid pickle chain can be successfully used in concentrations of sulphuric acid up to 20 per cent and at temperatures up to 200 F. It will not scale below 1700 F and has a remarkably long life when utilized below that temperature, the firm reports. It is available in sizes of $^9/_{32}$, $^3/_8$, $^1/_2$, $^5/_8$, and $^3/_4$ in. with working load limits of 1600, 3200, 5200, 7500, and 9850 lb respectively.

Type 321 stainless steel chain possesses the desirable properties associated with 18-8 stainless, the company states. By use of a titanium addition, inter-granular corrosion in the carbide precipitation range of 800–1650 F has been eliminated. It is recommended by the manufacturer for use in nitric acid pickling operations under high temperature and/or atmospheric oxidation conditions. These chains are also provided in the same sizes and same working load limits as the acid pickle chains.

—K-41

Laminated-Plastic Tubing

Taylor Fibre Co. has extended the size range of its rolled laminated-plastic tubes by reducing the minimum inside diameter to .050 in. Its maximum ID for rolled tubing is 36 in.

The new range of small ID tubing was developed to meet the requirements of terminal insulators, contact pins, and parts for transistors, rectifiers, diodes and resistor tubes.

At present the sizes below .125 in. ID are furnished in Grade XX laminated plastic. This is a paper base, phenolic resin grade which has good electrical, mechanical, and physical properties, the firm states.

Rolled tubing is made by convolutely winding layers of resin impregnated paper or fabric under heat and pressure on a mandrel.

—K-42

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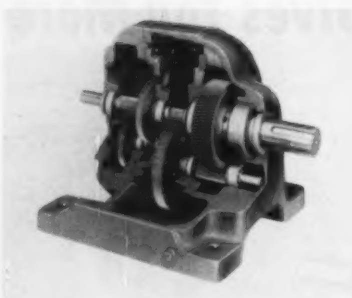

Helical Gear Drives

Link-Belt Co. now offers industry a quadruple reduction helical gear drive and new larger sizes of double and triple reduction drives to augment its present line of double and triple reduction in-line helical gear drives. Drives with capacities to more than 200 hp are available.

The extremely compact quadruple reduction speed reducer, available in five sizes, extends the range of ratios as high as 2217:1.

The simple gear arrangement of these speed reducers consists of helical gear trains operating in high capacity ball and roller bearings mounted in a cast iron housing.

Space requirements and layout problems are said to be minimized by locating input and output shafts in the same horizontal and vertical planes. Automatic splash lubrication of all moving parts is designed to assure dependable lubrication and operation at all speeds. **—K-43**

Stainless Filter Elements

A new line of Poromesh stainless steel, sintered and rolled, woven wire cloth type filter replacement elements for high temperature applications in hydraulic lines in aircraft and missile control systems is now available from Bendix Filter Div., Bendix Aviation Corp.

The new Model 62350 elements, have the same envelope size as AN 6235 standard pleated paper elements and fit standard MS-28720 and AN-6234 filter housings for 3000-psi and 1500-psi service respectively. They can be cleaned and restored to original filtering capacity whenever necessary, the company states.

The elements are made in two different types; one type with stainless steel, silver-soldered end caps for 500 F continuous service, and the other with aluminum epoxy resin-bonded end caps for 300 F continuous service.

Eight pore sizes from 5 to 250 micron particle ratings are available for the elements. Four element sizes of standard lengths and diameters are available. These provide flows of $1/2$, 3, 6, and 12 gpm of MIL-0-5606 fluid with 5-micron elements.

The elements can be supplied as individual units or delivered with MS-28270 or AN-6234 filter housings. **—K-44**

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1	16	33	45	151	162R	177	190	202TL	OBC
2	17, 18	34	46	152	165	178L	191	202TR	
4	19	35	47	153	167	178R	192	202BL	
6	20, 21	36	48	155	169	179	194	202BR	
7	22, 23	37	49	156	170T	181	195	203	
8	24	38	50	157	170BL	182	197	204	
9, 10	25	39	143	159	171T	183	198	211	
11	26, 27	40, 41	145	160L	171B	184	199	213	
12, 13	28	42	147	160R	173	185	200	215	
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MECHANICAL ENGINEERING—OCTOBER 1958—**Keep Informed Section**

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Powder Lance

The Oxweld ACL-3 powder lance, a new tool said to be capable of cutting through concrete or metal of any thickness, has been introduced by Linde Co., Div. of Union Carbide Corp.

Accurate control of intense heat is described as the key to operating the new powder lance. Lengths of standard black iron pipe are fitted into the front end of the unit, which is connected to an oxygen supply and a source of special metallic powder. The oxygen and metallic powder are mixed in the pipe and carried to the material being pierced or cut by the consumable pipe. This mixture is ignited at the end of the iron pipe, producing an extremely high temperature reaction that melts both ferrous or nonferrous material in its path. On materials such as concrete, aluminum powder is added to the metallic powder to intensify the cutting reaction. **—K-45**

Pressure Tubing

Pacific Tube Co. has installed new hydrostatic testing equipment providing hydraulic line proof testing up to 30,000 psi.

Primary function of the equipment is to test yield strengths of aircraft seamless and welded stainless steel hydraulic tubing from $^1/_4$–$^3/_4$ in. OD with .016–.065 in. wall thickness.

Additional plant equipment installation includes a new straightener for increased production capacity of tubing and bars. **—K-46**

Plastic Pump

Vanton Pump & Equipment Corp. announces that a new Marlex 50 polyethylene pump has been added to its plastic sealless pump line.

The new pump construction makes it possible to handle extremely corrosive fluids at temperatures up to 260 F, the firm states. It reports that conventional polyethylene is limited to 140 F service preventing it's use under conditions of elevated temperature operation or services requiring sterilization or boiling.

The new material possesses a close dense molecular structure which results in high tensile strength and low permeability. By nature of its long molecular chain length the polyethylene offers excellent impact strength and a high degree of crystallinity, the company says.

The new pump has a variety of interchangeable plastic body blocks and rubber or synthetic flex-i-liners. Stuffing boxes or shaft seals are eliminated from the pump since flanges on the liner straddle the body block and are pressed to its sides by concentric grooves in the bearing pedestal and cover plate. Thus the liquid is confined to a channel formed by the outer surface of the liner and the inner surface of the body block while all mechanical action and moving parts are on the inside of the liner completely out of the fluid passage. **—K-47**

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Two-Stage Vacuum Pump

Design improvement of its two-stage vacuum pump (evactor), used for steam turbine condenser service, is announced by Allis-Chalmers.

The new pump arrangement, shorter and more simple in construction than the previous model, provides equipment that is more easily serviced, the firm reports. The motor has been moved from the middle of the set-up and placed at the end.

A standard single-shafted motor of open or closed design can be used. Users may now employ a totally enclosed motor in outdoor locations or harsh atmospheres or they can use an open motor.

Simplified piping for interstage connection is more compact. Eliminated are parts previously considered essential, i.e., moisture separator on the interstages and the interstage water alarm. **—K-48**

Gear Drive

A new low maintenance gear drive with a solidly silent operation has been introduced by Pfaudler Co., Div. of Pfaudler Permutit Inc.

The firm says the unit is intended for use on 300 through 4000 gal agitated vessels. Design advances cited by the company for the unit include pilot fit, interchangeable seal or stuffing box, wide bearing span, hardened and lapped spiral bevel gears, five leak proof cil seals, and new T head draw bar design. **—K-49**

Propeller Fans

A new line of special purpose propeller type air moving units for cooling and ventilating electronic equipment cabinets or other applications were low pressure, high volume air is required is available from American-Standard, American Blower Div. **—K-50**

Bed Type Milling Machine

Introduction of a bed type milling machine which provides automatic production milling by dialing the results directly from the blue print ahead of time, has been announced by Kearney & Trecker Corp.

The firm says the operator dial-programs machine functions on a unique control panel, by means of phase-switch dials, which control each machine function automatically. Any number of functions can be phased into a cycle, including automatic quill retraction, rise and fall to the head, and tracer control.

Two-way milling cycles with automatic center stop for load and unload can be obtained by pressing a button to resume the cycle, the company explains. Stops can be made to occur at any place in the cycle. Changing from automatic to manual operation is made by the flick of a switch.

Seventy-two standard models in both simplex and duplex styles, with power ranging from $7^{1}/_{2}$ to 30 hp are available. **—K-51**

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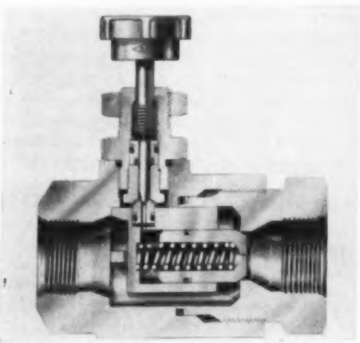
Automatic Shaft Seal

An automatic shaft seal for smaller water and oil pumps has been introduced by Schwitzer Corp. The seal, designated Type J-2, is available in sizes for $\frac{5}{8}$ and $1\frac{1}{8}$ in. shafts. Maximum design pressure is 60 lb.

A special molded alloy carbon washer with greatly enlarged driving area is used in the seal to provide more positive contact and longer life. Pressure is said to be equalized over the entire contact area, reducing wear to the minimum. The washer will not score, seize or warp; is unaffected by changes in temperature, and withstands antifreeze, acids, and other chemical solutions, the firm states.

The new seal is interchangeable with most standard seals. **—K-52**



Shutoff Valve

Easy on-and-off control of hydraulic circuits operating at pressures up to 5000 psi is the feature of the Ez-O-Trol in-line shutoff valve announced by Republic Mfg. Co. It is designed for applications where liquid is not subject to reversals of flow.

In operation the valve is seated by back-pressure in a balancing pressure chamber. Actuating the pilot causes an unbalanced condition by allowing the back pressure to escape. This quickly opens the valve to practically unrestricted throughflow, resulting in exceedingly low pressure drop. Pilot operation may be directly controlled by a single turn of a handle having less than 10 lb torque, or remotely controlled by 50 to 150 psi air operated diaphragm, or direct-acting solenoid. These pilot controls are external, and all three types are interchangeable on the same size body. The manually controlled type may be panel mounted ($\frac{3}{8}$ in. max thickness), with only the pilot control handle on the front of the panel.

In standard units the valve body is aluminum alloy, with internal parts of stainless steel. Size range is $\frac{1}{2}$ to 2 in., with either female pipe threads or internal straight threads for O-ring seals. Temperature range is -65 to $+200$ F. **—K-53**

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Energy Cartridges

Flexi-Pak energy cartridges, in which pre-assembled stacks of belleville spring washers are held together by a flexible elastic covering, are now available from the divisions of Associated Spring Corp.

This new form of Cartridge is designed for applications where pins or rivets cannot be used to hold the washers together because the washer walls are too narrow, or where retaining rings or cores cannot be used because there is not sufficient vertical or radial clearance.

Two types of covering are being offered: a molded covering, which is cured around the washers while they are under a slight load, and a dipped or sprayed coating, which is applied to the stacks while they are held firmly together but relaxed.

The firm says the molded covering, made of rubber, neoprene, or vinyl flexible material, is sufficiently rigid that it cannot be forced between the washers and will not bulge outward in service. Lips hold the washers securely, yet permit them to be snapped out of the covering easily if replacement is necessary. The dipped coating is applied in latex form. Both types of covering serve to reduce the total weight of the assembly, reduce friction and contribute to noise-reduction, the company states. **—K-54**

Hydraulic Power Unit

Circuitpak, a new low-cost hydraulic power unit has been announced by Hydraulics Div., Brown & Sharpe Mfg. Co.

Assembled with electric motor, hydraulic pump, valves and oil reservoir, the unit is manifold-circuited for direct connection to cylinder lines.

Four pump capacities from .8 to 5 gpm are available with 1, 1½ or 2 hp capacitor-start electric motors and up to four solenoid-operated four-way valves. Reservoir capacity is 2 gal with nickel-tube heat exchanger cast in housing for cooling oil. Operation is at 3600 rpm with pressures up to 1000 psi.

Circuitry employs series connection of valves to effect a priority system of operation whereby oil is blocked from all valves farther down the circuit when any valve in the series is shifted. Return lines are ported directly to the tank. To eliminate overheating when valves are in neutral position, pump discharge is circulated at negligible pressure. The company says the unit may be applied with cylinders of all sizes to provide power for spot welding, vise clamping, indexing, cutting, moulding, rivetting, lifting, pushing, feed and traverse, and many other machine and materials handling operations. **—K-55**

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High-Vacuum Valves

Three small right-angle vacuum valves, offering lower impedance than vacuum globe valves of the small nominal size, have been added to the line of valves offered by the Rochester Div., Consolidated Electrodynamics Corp.

Made of cast bronze, the new small right-angle valves are available for either pneumatic or manual operation.

Connections for the new Type VRA valves, available in $^1/_2$, 1-, and $1^1/_2$-in. sizes, may be made with a solder joint or with a standard NPT pipe thread connection which would be useful where valves may have to be removed. The firm says a solder connection is of particular importance in high-vacuum installations where a pressure of less than 10μ of Hg is to be created and the elimination of the smallest possible leaks in a prerequisite for exact performance. —K-56

New Hand Drivers

Three new designs of Safe-Torque hand-operated drivers are announced by Scully-Jones and Co.

Work capacities available in the new line are: 0 to 25, 0 to 60, in-lb, and 0 to 96 in-oz.

Torque is preset by engaging the internal adjusting screw with a conventional socket head wrench, turning it clockwise to increase torque and counter-clockwise to decrease torque.

The two larger sizes of drivers have a calibrated torque adjusting screw at the top, while the 0 to 96 in-oz driver uses lines scribed on the projecting drive spindle. These line markings may be correlated with a torque chart provided by the firm. Once preset to the desired torque, the driver will repeat to ± 1 in-oz, the company reports. —K-57

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Cutting Machine

A small, heavy-duty, high speed dry abrasive cutting machine is announced by Allison-Campbell Div., American Chain & Cable Co.

Designated as the Sever-All, model 1-A and designed for use in metal-working shops, factories, mills, maintenance repair depots, the device has the capacity to cut metals of practically all analyses up to 2 × 2 in. solids, 3 in. standard pipe, 3 × 3 in. angle iron and 4 in. channels, the firm states. High quality cuts are made at the rate of 3 to 6 sec. per sq in. of metal.

The firm says a feature which enables the unit to cut larger cross-sections with a fine quality of cut, is the oscillating action of the abrasive cutting wheel. Because oscillation reduces the arc of contact between the wheel and the work, it provides faster cutting action, cleaner cuts and greatly increased wheel life, the company says.

For cutting of small cross-sections of metal, the unit is operated much like a standard chop-stroke machine. For cutting larger areas, provision is made for manual oscillation of the cutting wheel by means of a hand ever. This oscillating action reduces the cutting pressure required.

Abrasive cutting wheels of 12 in. diam have been developed by the manufacturer for use with the machine. Power is furnished by a 3 hp high torque motor. Positive drive between the motor and the abrasive wheel spindle is accomplished by means of a timing belt. Teeth in this belt mesh with grooves in the pulleys. —K-58

BUSINESS NOTES

Defense Products Office

A Long Island defense products sales office has been opened at Roosevelt Field by Westinghouse Electric Corp. Located in the new Franklin National Bank Building at 600 Old Country Road, Garden City, N.Y., the office will be responsible for the sale and application of the company's electronic and electrical defense products.

Equipment Firm Purchased

Supreme Steel Equipment Corp., Brooklyn, N. Y., announces the outright purchase of all the machinery, patent rights, and trademarks of the Universal Steel Equipment Corp., Long Island City, N. Y. Key personnel of this company have been absorbed into the Supreme organization. This acquisition marks the re-entry of Supreme into the industrial steel equipment field.

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Establishes Separate Corporation

Cleaver-Brooks Co., packaged boiler manufacturer, announces plans to establish its Special Products Division as a separate corporation. The new firm will be named Cleaver-Brooks Special Products, Inc.

LATEST CATALOGS

Scrubber

Centrifix Corp. announces Bulletin 500 covering its WD scrubber, which is guaranteed to remove 99.5 per cent or more of all solid or liquid entrainment in gas or vapor.

The unit is said to be applicable to removing oil mist, acid fumes, dust, fly ash, and for humidifying gases and evaporative cooling of water. —K-59

Porcelain Enamel

Porcelain Enamel Institute, Inc. has issued a folder illustrating and describing characteristics and design applications of porcelain enamel.

The folder includes photos of the material in industrial and commercial applications and lists additional data giving detailed information on properties and characteristics. —K-60

Packaged Steam Generators

Titusville Iron Works Co., has announced Bulletin B-3255 covering its shop assembled packaged steam generators from 10,000 to 60,000 lb of steam an hour.

The bulletin shows construction, performance, and maintenance characteristics of the units, and a specification sheet giving dimensions and ratings is included. —K-61

Free, Directional Gyros

United Aircraft Corp., Norden Div., has released a 64-page illustrated bulletin that explains how gyros work, gyro terms, and gyro operating principles. Specifications for rate gyros, free gyros, directional gyros, and compensated vertical gyros are included. —K-62

Induction Heating

Magnethermic Corp. announces a bulletin on high frequency induction heating equipment.

The 12 pages include information on heat stations and generator control units; application photos and data on heat treating, annealing, brazing, forging, shrink fitting; data on vertical motor generator sets; and typical layouts on low power portable, 50 kw and below, high power multiple station output, 50 to 350 kw, high power single station output, 50 to 300 kw. —K-63

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Pressure Gages

United States Gauge, Div. of American Machine and Metals, Inc., announces Catalog 305 which illustrates and describes pressure gages for general utility, altitude, refrigeration, ammonia, hydraulic, applications.

Listed are high pressure, vacuum, and low pressure, differential gages, pressure switches and alarms. **—K-64**

Port Fittings

Flodar Corp. has announced publication of a four-page illustrated folder describing its new line of straight-threaded port fittings designed to replace conventional pipe thread and O-ring styles.

The firm says the fittings are available in all standard shapes, and are designed to save space in confined areas and when making multiple connections. Each consists of a swivel body and externally threaded nut. The fittings are claimed to have an unusual design that eliminates O-rings, provides leak-proof metal-to-metal seal, requires no grinding or special finishing of the seat and can be installed on 1-in. centers with adequate clearance for installation. **—K-65**

Feedwater Regulator

Bulletin 1044, published by Copes-Vulcan Div., Blaw-Knox Co., describes the BI feedwater regulator. This is a single-element unit employing a thermostatic-tube level controller which actuates a regulating valve in the feed line.

It is said to be suited for boilers carrying reasonably steady loads at steam pressures from 10 to 785 psig. The bulletin illustrates the working parts and a schematic diagram shows how the different units are arranged into a complete control system. Included is a table of specifications and a list of features. **—K-66**

Buttweld Tubing

A Handbook of Cold Drawn, Buttweld Mechanical Steel Tubing has been published by Pittsburgh Tube Co.

Metallurgical, mechanical and engineering data are included, and 60 pages of text and 75 photos and drawings explain each step in buttweld production, finishing, and inspection, the types of product available through various mill treatments and supplementary forming operations. Buttweld parts used in industrial fabrication are illustrated. **—K-67**

Transistor Servo Amplifier

Described in a two-page brochure, Librascope's miniaturized transistor servo amplifier, named Model 501-1, features $^3/_4$ w output over a wide range of temperatures.

The bulletin provides performance data along with wiring diagrams and dimensional information. The amplifiers described in the brochure weigh less than one ounce with a volume less than $^3/_4$ cu in. The units have a power requirement of 28 volts d-c at 60 ma for full output. **—K-68**

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Hot Water Generators

Revised specification sheets with a separate section on hot water generators have been issued by Cyclotherm Div., National-U.S. Radiator Corp. Each of the 10 hot water models is given a com plete page of description and specifications. —K–69

Steam Traps

V. D. Anderson Co., announces publication of a 40-page engineering manual for assisting in the sizing, specifying, selection, and buying of steam traps and other fluid specialties.

The booklet is primarily an engineering manual. It includes data necessary to engineer a trap installation. Also included are twenty-six piping details showing the correct method of installing traps for a wide variety of applications. These details show the location of traps, valves, strainers, unions and related fittings. —K–70

Stainless Flexible Hose

A four-page engineering data and specification folder, SSDS-562, has been issued by Allied Metal Hose Co.

It points out that by taking the strength of stainless steel and combining it with just the right wall thicknesses for ductility, Allflex hose achieves flexibility and can handle safely pressures up to 4000 psi, temperatures through 1500 F. The hose is used to absorb vibration; correct for misalignment and offset motion; as chemical loading hose; for weight tank connections; as an expansion compensator. —K–71

Valve Regulators

The functions, applications, and operation of Rockwell-Nordstrom valve regulators with Republic controls are described in an eight-page bulletin issued by Rockwell Mfg. Co.

The valve regulators are pneumatically controlled, cylinder operated, lubricated plug valve regulators. They are designed to provide high-pressure, large volume, gas regulation with minimum pressure loss. The controls consists of a vector type pressure controller and a feed-back type valve positioner. —K–72

Gasoline Engines

Two revised two-page bulletins describing, respectively, improved two-cylinder and four-cylinder air-cooled gasoline engines have been issued by Hercules Motors Corp.

In addition to photo-illustrated descriptions, the new bulletins include basic installation diagrams and a power chart indicating horsepower rating, torque, and performance characteristics with which ratings can be determined under varying conditions in a number of applications. Power ratings shown are for the power unit equipped with all accessories described in the bulletins and are in accordance with testing standards and ratings approved by the Internal Combustion Engine Institute. —K–73

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Tubular Products

A 24-page booklet, Quality Control, published by Tubular Products Div., Babcock & Wilcox Co., describes the various testing and inspection methods used during the manufacture of seamless and welded carbon, alloy, and stainless steel tubular products.

The booklet explains how inspection and testing techniques are integrated into the manufacturing process. **—K-74**

Titanium Tubing, Pipe

Physical and mechanical properties, fabrication characteristics, and corrosion-resistance of titanium tubing and pipe are described in a bulletin issued by Alloy Tube Div., Carpenter Steel Co.

Data includes working instructions for machining, forming, welding, heat treating and cleaning. Resistance of commercially-pure titanium to 80 corrodents is shown. Applications for use in the aircraft, chemical, and marine fields are also cited. **—K-75**

Insulation System

The Silco-Flex impervious insulation system for motor and generator stator coils is described in a new bulletin, O5B8341A, released by Allis-Chalmers.

The insulating system has as its basis a semi-organic silicone elastomer characterized by extreme chemical stability and retention of original properties under the most adverse conditions. Properties attributed it as described in the bulletin include resistance to aging, abrasion, chemicals, corona, fire, moisture, oil, solvents, fungus, carbon black and arcing. **—K-76**

Glassed Steel Reactors

Installation, operation, and maintenance procedures for glassed-steel reactors are detailed in Bulletin 955 published by Pfaudler Co., Division of Pfaudler Permutit Inc.

Information is given on such items as proper gasketing for use in varying corrosive environments, jacket-cleaning techniques, repair procedures for severe and mild chemical service, and a special section devoted to thermal shock. Proper procedures for inspecting the glass, protecting against exterior vessel damage, storing glassed-steel equipment and returning equipment to the factory for repair are also outlined in the new manual. **—K-77**

Cast, Forged Valves

A 92-page catalog, describing its line of cast and forged steel valves for power, petroleum, chemical, marine, and industrial applications, has been announced by Edward Valves, Inc., Subsidiary of Rockwell Mfg. Co.

A visual index in the front shows every valve cataloged, arranged in groups according to type. Other indexes arrange the valves by functions performed and by the manufacturer's figure numbers. The new catalog shows all the standard valves made by the firm. **—K-78**

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Spherical Bearings

A new catalog sheet has been released by Sealmaster Bearing Div., Stephens-Adamson Mfg. Co. The piece illustrates the features of Spherco spherical bearings and rod ends, including solid race construction and positive control linkage. **—K-79**

Lead Treated Steels

Copperweld Steel Co., Steel Div., has issued a bulletin on lead treated steels.

Included are case histories, characteristics, and metallurgical properties of the materials. A summary of investigations on lead treated alloy steels is also included in the booklet. **—K-80**

Rotary Positive Blowers

A new compact design for rotary positive blowers is presented in a bulletin issued by Roots-Connersville Blower, Div. of Dresser Industries, Inc.

The blowers, designated Type RAS, feature a vertical arrangement of the impellers to provice horizontal inlet and discharge connections. A new "segment waist" impeller contour permits larger volumes and higher pressures at no increase in operating speed, the firm reports. **—K-81**

Forced Draft Boilers

Compak forced draft series of water tube package boilers is described in Bulletin No. 1200 released by International Boiler Works Co.

The bulletin explains that use of forced draft burners for oil/gas firing eliminates need for elaborate controls, stack or induced draft fan. Multi-pass gas flow coupled with water tube construction is designed to assure high thermal efficiency and rapid steam or hot water generation. **—K-82**

W Drive Maintenance

A 20-page manual containing installation, operation, and maintenance instructions for gear drives of the W type is now available from Pfaudler Co.

The drive is described as a compact, quiet operating unit adaptable to a variety of agitated reactions. Standard 2.5 W, 3 W, 4 W, and 5 W drives are supplied with constant speed sheaves. These sheaves are furnished with static-resistant belts and may be combined to produce the necessary speed for any desired agitation. As an alternative, variable pitch sheaves with static-resistant belts can be supplied to give agitator speeds ranging from 600/120 to 100/20. **—K-83**

For Consulting Engineers

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Liquid Heaters

S. Morgan Smith Co. has issued a bulletin illustrating and describing its line of liquid heaters for indirect processing heat up to 650F.

The booklet contains a general discussion of the units and gives details and dimensions on single-pass and three-pass series. A schematic diagram shows various arrangements for delivering accurately controlled heat with the firm's systems. **—K–84**

Hydrogen Zeolite Softener

Cochrane Corp. announces publication of an eight-page bulletin on the hydrogen zeolite process.

It indicates advantages of the process, its chemistry and variations in methods for neutralizing mineral acidity of hydrogen zeolite effluent. Types of zeolites are discussed as well as relative advantages and disadvantages of various regenerants. **—K–85**

Lubricant Application

Farval Corp., has published a bulletin on modern methods of lubricant application.

The booklet covers the four basic principles involved, various types of systems, electrical controls, mist and fog lubrications, circulating oil systems, spray lubrication of open gears, and data on the broad field of equipment and ideas presented for this field. **—K–86**

Filter Paper

Gelman Instrument Co. has issued a bulletin illustrating and describing its HV-70 filter paper manufactured of asbestos-vegetable fibers and used for filtration of radioactive aerosols.

The firm states that filter circles may be used in conjunction with its aerosol filter holders for air sampling, or for stack sampling. A silicone treatment makes the paper water repellent so that it may be used to sample saturated air streams where other papers would break. **—K–87**

Thread-Roll Dies

Aircraft-quality thread-roll dies, now available to industry for producing external screw threads on both fine and coarse series, are reviewed in a bulletin published by Standard Pressed Steel Co.

Available in all standard thread sizes from No. 10-32 to 1 in.–14, the flat dies are identical to those used by the firm in producing airframe and high temperature engine bolts and a variety of titanium fasteners to military standards. The four-page bulletin reviews design features and the reliability factor of the high-precision dies, discusses some of the applications and the close tolerances held. **—K–88**

Silicone Fluids

An engineering guide to silicone fluids for mechanical applications has been published by Dow Corning Corp.

It is a compilation of information essential to selecting the most suitable silicone fluid medium when designing for reliable, uniform performance. Typical applications cited show how silicone fluids are used to advantage in damping, springing, coupling and related mechanical applications. **—K–89**

Spring Wires

A special grade of mechanical spring wire, Special HB, manufactured to extremely close tolerances, is featured in folder DH-107A, released by Page Steel and Wire Div., American Chain & Cable Co.

The grade is dry drawn to approximately music wire tensile strengths. Tensile strength, chemical composition, range of diameters, dimensions, finish, packing, marking, and minimum production quantities are listed in the bulletin. **—K–90**

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Automation Controls

A new edition of Bulletin PA 561 on automation control applications is available from Electronics Corp. of America, Photoswitch Div.

The 24-page illustrated brochure contains specifications, descriptive data, operational charts, and a selector guide for photoelectric systems for industrial control applications. These include long range protection against intrusion, counting, sorting, inspecting, precision registration, and high-temperature measurement. **—K–91**

Humidity Conditioning

Surface Combustion Corp., Air Conditioning and Drying Div. has issued a bulletin on humidity conditioning as a new key to higher production, lower costs, better products, reduced absenteeism.

The booklet contains a series of case histories, illustrates signs of humidity problems, and gives examples of various industrial air conditions. **—K–92**

Centrifugal Castings

Sandusky Foundry and Machine Co. has issued Bulletin 200 covering its centrifugal castings and their use in cylindrical applications.

The booklet gives data on heat, corrosion- and abrasion-resistant alloys, nonferrous compositions and plain carbon and alloy steels available for use in centrifugal castings. **—K–93**

Reducers, Gears

Ohio Gear Co. has issued a pocket-sized catalog and handbook covering its line of speed reducers, gears and sprockets.

The booklet, which gives dimension diagrams and tables of specifications for each unit, also contains application photos, a photo-story on the firm's manufacturing techniques, and processes and engineering data pertaining to the selection of equipment. **—K–94**

Digital Computers

A brochure is available from Thompson-Ramo-Wooldridge Products Co. on digital computer control and data logging. Included is a description of the RW-300 digital control computer and discussions of process control, data logging, pilot plant and test facility applications for computer control systems.

The computer, which incorporates analog-digital conversion equipment, can handle up to 1024 analog inputs and up to 128 analog outputs. It can also operate with automatic typewriters, paper tape and punched card readers, paper tape and card punches, and on-off devices. **—K–95**

Miniature Mercury Switch

Micro Switch Div., Minneapolis-Honeywell Regulator Co., has issued a new data sheet, No. 149, on the ultra-small catalog listing AS419A1 mercury switch.

The sheet gives features of the tiny switch which is $^{9}/_{10}$ in. long and weighs 1.8 g complete with leads. **—K–96**

Specialty Steel

Crucible Steel Co. of America has issued an eight-page booklet illustrating and describing Maxeloy, a lightweight, longlife, corrosion-resistant speciality steel.

The booklet provides engineering property and application data along with design and cost-saving information. **—K–97**

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Dry Purifier

Centrifix Corp., has issued Bulletin 600 illustrating and describing its CD dry purifier for removing materials entrained in any gas or air stream at any temperature without heat loss or wetting agent.

The unit is claimed to have an efficiency of 90 to more than 99 per cent and can be used for fly ash, cement, sintered ore, powdered fuel, catalyst dust, drugs and chemical products. **—K-98**

Safety Relief Valves

A four-page bulletin, prepared by McDonnell & Miller, Inc., covers the recently expanded line of 230 and 240 series safety relief valves for hot water space heating boilers.

The bulletin contains diagrams and basic facts on the subject of selection and installation of relief valves in keeping with the current requirements of the ASME Low Pressure Heating Boiler Code Section IV. It also discusses the conditions safety relief valves must meet in hot water heating service and points out the advantages to be gained by using manifold type of valves with progressive settings for large boilers. **—K-99**

Plastic Dall Flow Tube

A recently developed lightweight corrosion-resistant insert plastic dall flow tube, Model DFT-PI, is the subject of a four-page bulletin issued by Builders-Providence, Inc., Div. of B-I-F Industries, Inc.

The bulletin includes photographs, dimensional, and cost-comparison tables, cutaway views and performance charts. The new flow tube is made of fiberglas-reinforced epoxy or polyester resins with metallic throat lining, and is available in a variety of sizes and flange and throat materials. **—K-100**

Bar Automatic

An eight-page illustrated bulletin, MRA-58, describes the National Acme Co's. newest and smallest multiple spindle bar automatic, the $^{7}/_{16}$-in. RA-6.

The unit was designed for either long or short run production of small to miniature components where high production rates must be kept compatible with precision. The bulletin lists and shows design and construction features, standard accessory attachments for threading and tapping, high speed drilling, pick-off and back-finishing and accelerated reaming. **—K-101**

Hydraulic Press Brakes

A new catalog, No. 2024A, describing a new line of Steelweld hydraulic press brakes is offered by Cleveland Crane & Engineering Co.

The brakes are said to provide positive overload protection; ram reversible at any point; stroke adjustment for any length; fast ram approach and return with slow-speed pressing; constant power during entire stroke. **—K-102**

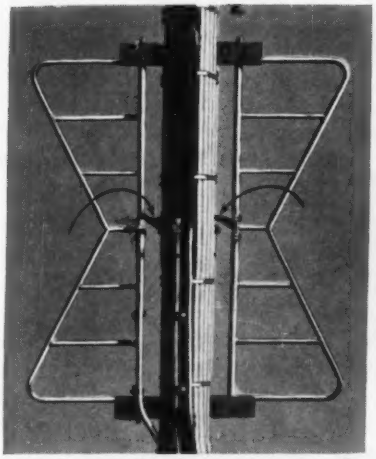
Level Controller

Details of a compact pneumatic-electronic control device, said to detect and control changes in media level with exceptional precision are given in Technical Bulletin RF-587 issued by the Aeronautical and Instrument Div., Robertshaw-Fulton Controls Co.

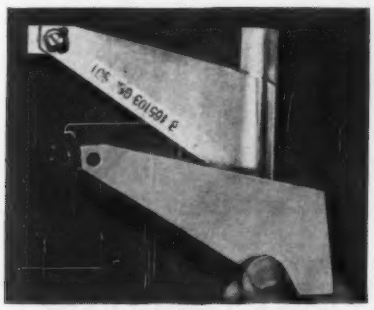
Consisting of a capacitance-sensitive probe and a controller, the pneutronic level controller comprises a complete system for level control in a wide variety of liquids and granular media through precise pneumatic pressure output. It is claimed to be valuable for application in vessels or small tanks which do not permit internal installation of conventional systems. **—K-103**

TRY A FRESH APPROACH

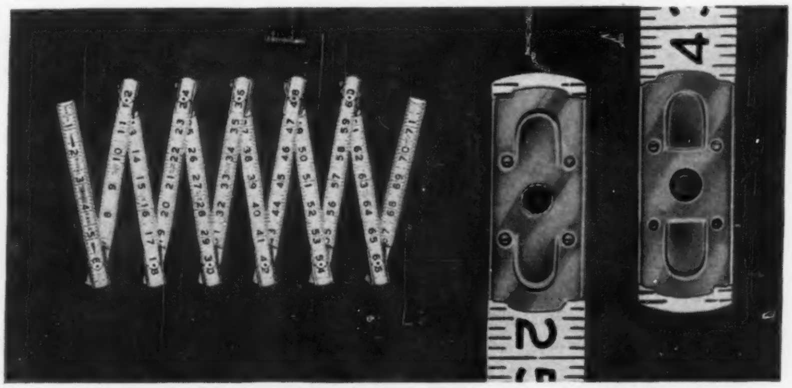
Don't just take your metals for granted—specify the properties you need. The Man from Anaconda may come up with some very interesting answers.



Up where TV broadcast antennas stand, normal wind causes flexing of metals. So jumpers between coaxial cables and radiators must be resilient – beside being conductors, giving some structural support. Ordinary phosphor bronze seemed adequate, but there were fatigue failures.

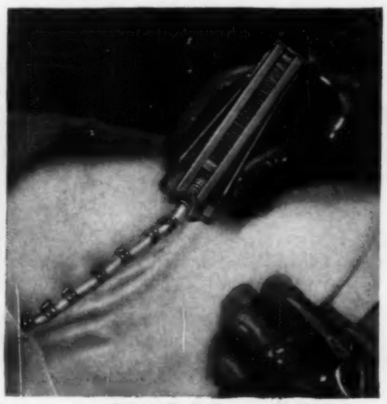


RCA listed desirable properties of phosphor bronze – added *extra*-high endurance, *extra*-long fatigue life. American Brass suggested Duraflex®, Anaconda superfine-grain phosphor bronze. RCA tried it, found it the answer—at no extra cost—specified Duraflex to the manufacturer, Dielectric Products Engineering Co., Inc., Raymond, Maine.



To stimulate sales of its top-quality folding rule, and to meet Navy specifications, Eagle Rule Mfg. Corporation sought a metal for rule joints that would resist wear and corrosion, and provide the proper spring tension. Phosphor bronze, which had these qualities in excess of needs, cost too much.

American Brass suggested three alloys. Eagle Rule chose Ambronze-420 (88 Cu, 11 Zn, 1 Sn) because rule joints of this alloy met all requirements, withstood 400,000 cycles in wear test (Navy required 7000). It cost only pennies per pound more than yellow brass, much less than phosphor bronze.



Technical Oil Tool Corp. asked Anaconda to help select the metal for a new magazine-type clip used to close surgical incisions. The metal had to provide the right tension to hold edges together, yet open easily—form readily, hold sharp die-cut edges, be proved in surgical use.

American Brass technical specialists suggested Nickel Silver, 18%-719 as best suited to meet all requirements. Autoclip, shown in use above, is the result. Incisions are held together with least damage to tissues. Surgeons can work faster in applying and removing clips.

STARTING with 93 standard alloys, The American Brass Company can make minor variations in composition, fabrication, and annealing to provide an almost unlimited number of combinations of useful properties. When new or unusual problems arise, ask for the help of the Technical Dept. in selecting the right metal. For such help or a copy of Publication B-32, "Anaconda Copper & Copper Alloys," write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario, Canada.

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from Donald W. Douglas, Jr.

President, Douglas Aircraft Company

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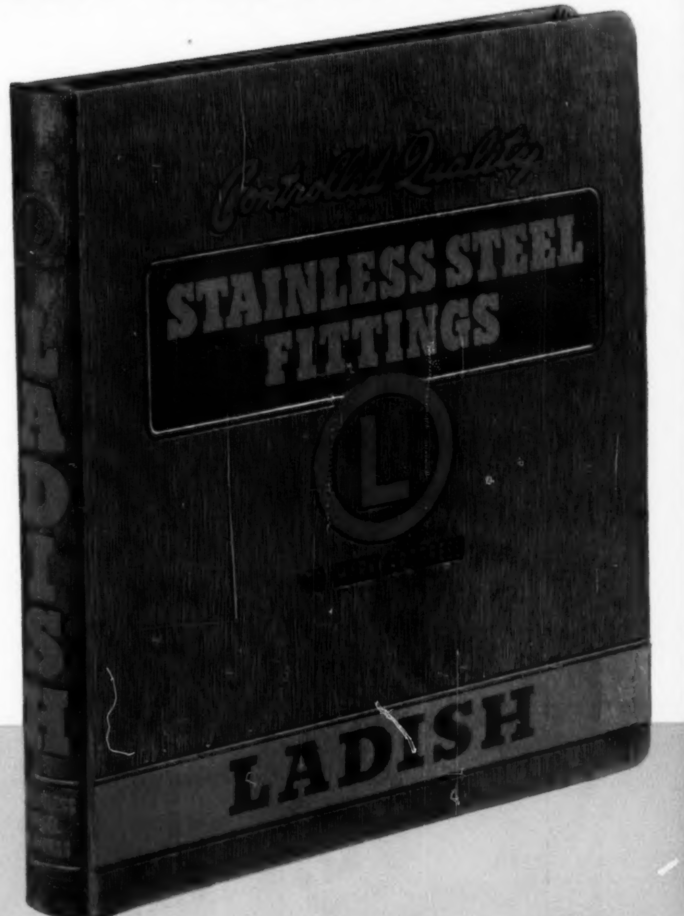

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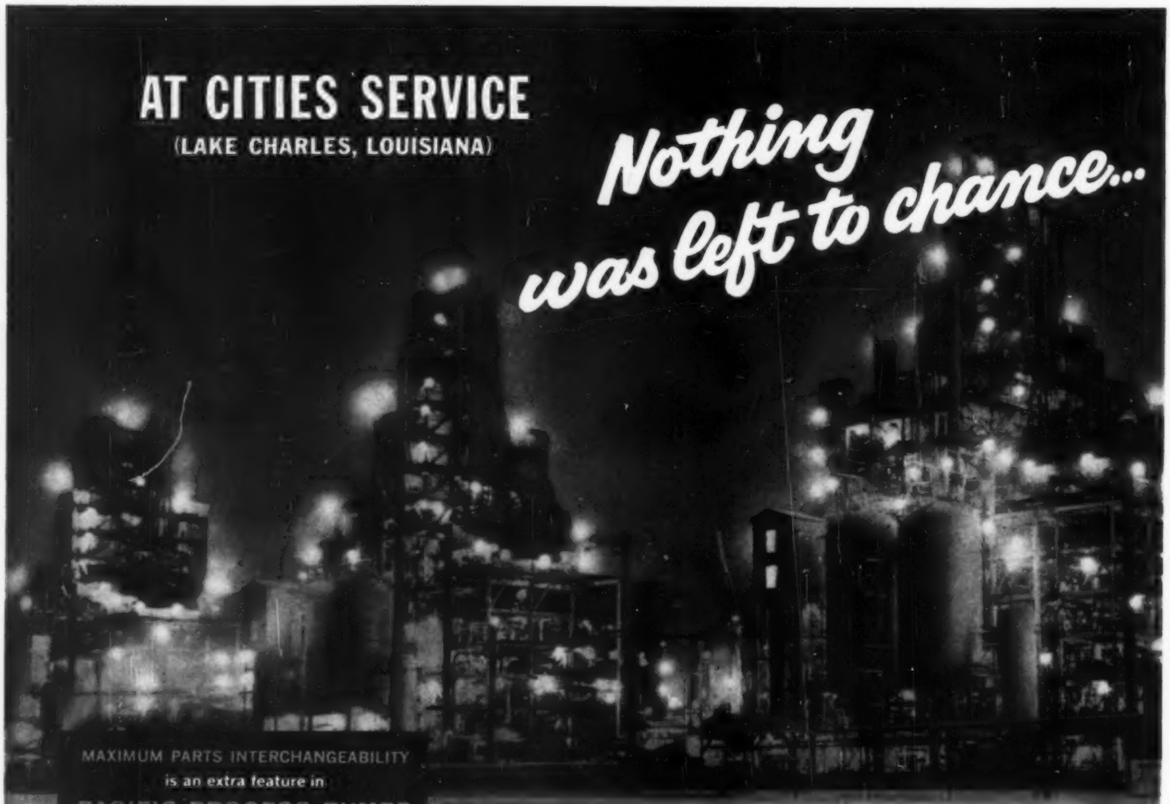

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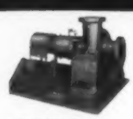

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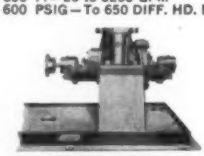

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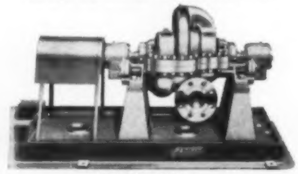

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Elsewhere throughout Cities Service, P.C.I. and Cit-Con operations, Pacific process pumps are delivering equally dependable 'round-the-clock service...convincing evidence that "nothing was left to chance."

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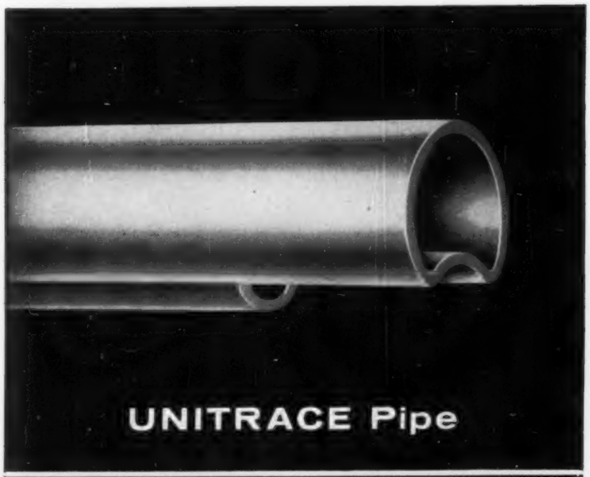
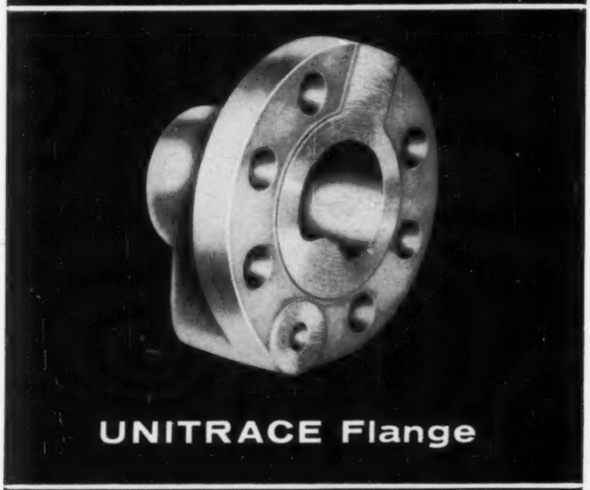
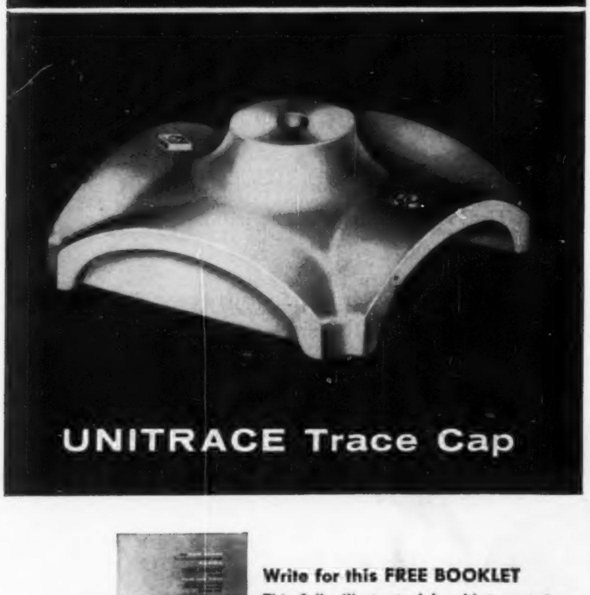


UNITRACE Pipe



UNITRACE Flange



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to cut costs and raise efficiency of steam-traced piping

Users of steam-traced pipe have found that valuable savings in cost plus greatly improved efficiency are automatic when they use ALCOA® UNITRACE. It provides steam and product passages extruded in a single unit of light, strong, corrosion-resistant aluminum alloy... completely eliminating the need for costly external steam jackets or inefficient tracer tubes. Now a new flange and trace cap provide fittings and connections designed for UNITRACE which are compatible with conventional piping. You can now design completely integrated UNITRACE piping systems and get all these benefits:

Low heat loss . . . high internal heat transfer
The recently introduced *round* configuration of UNITRACE makes possible most efficient internal heat transfer with minimum external radiation loss.

Easy, economical joints and connections
The special UNITRACE Flange mates with all 150-lb ASA flanged connections, permits use of standard flanged valves or other flanged connections. And the new UNITRACE Trace Cap permits quick, easy assembly of cross or tee connections.

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The efficiency of UNITRACE often makes insulation unnecessary. When it *is* needed, standard preformed insulation can be used. UNITRACE saves extra dollars by employing smaller diameter insulation than conventional systems.

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Thanks to the natural corrosion resistance of aluminum, UNITRACE is ideal for handling naval stores, molten sulfur, ammonium nitrate solutions, glacial acetic acid, fatty acids, tar, pitch, wax, urea, and similar products requiring heated transfer lines.

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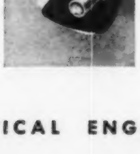

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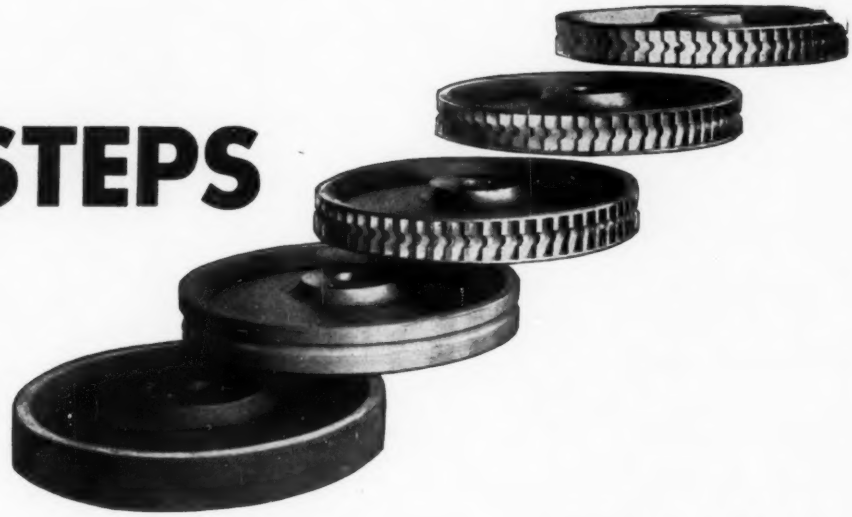
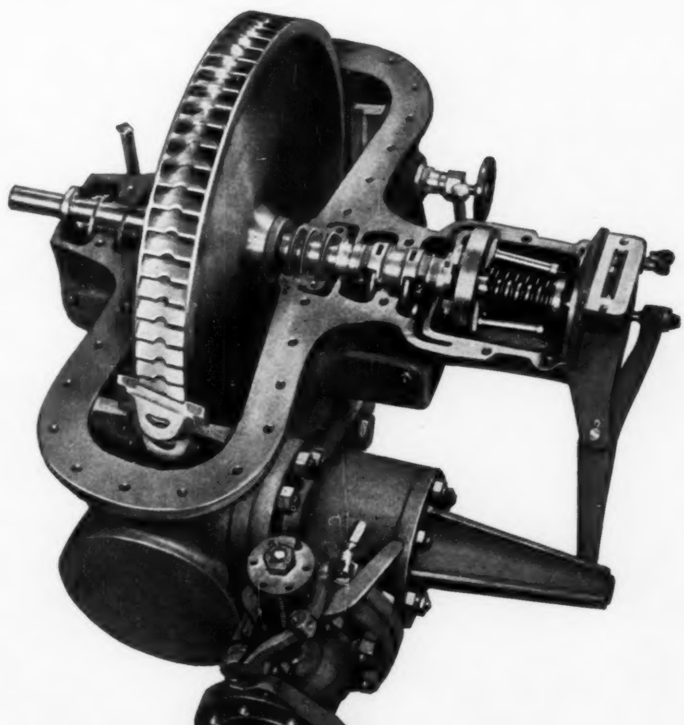


in making an almost indestructible turbine



The rotor of a Terry solid-wheel turbine is a single forging of special composition steel. It is first rough turned in two operations, as shown, and then two cuts are taken to mill the semi-circular buckets from the solid metal. The wheel at the top has been finished, ready for mounting on the shaft. *The result is a single-piece wheel with no parts to loosen or wear out.*

Blade wear, which might occur after many years of usage, is not important, because the power-producing action of the steam takes place on the curved surfaces at the backs of the buckets. Thus wear does not materially affect horsepower or efficiency.

The blades can't foul. They have a one-inch clearance, and are further protected by the projecting rims at the sides of the wheel.

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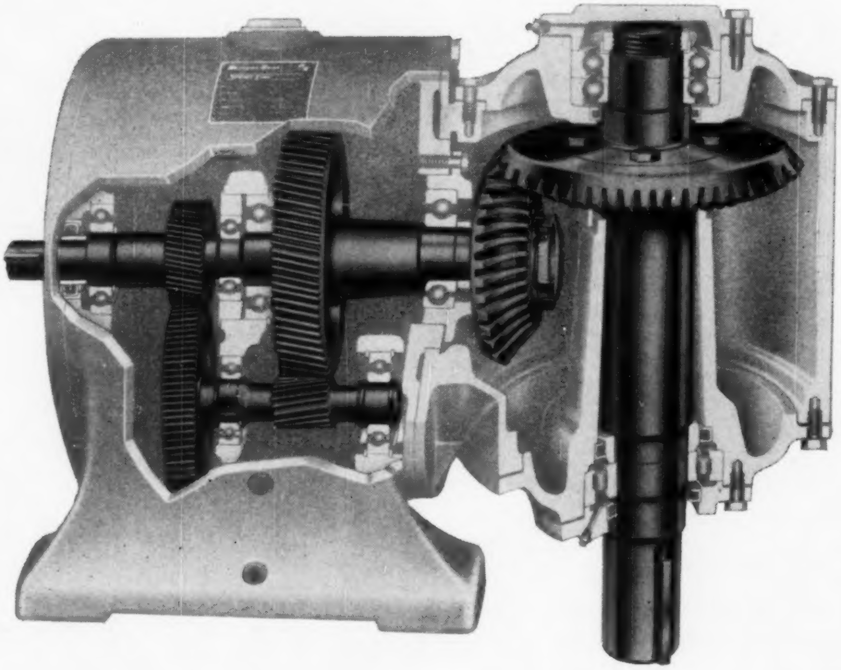

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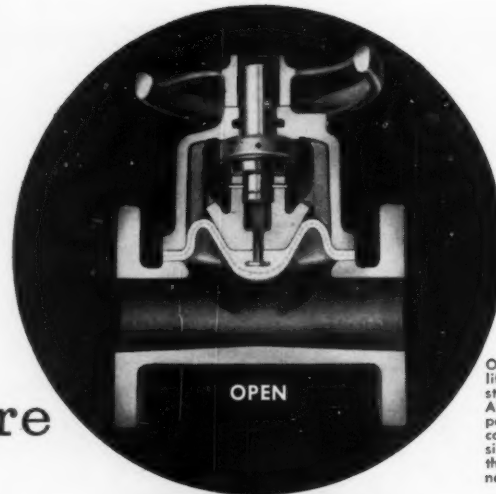
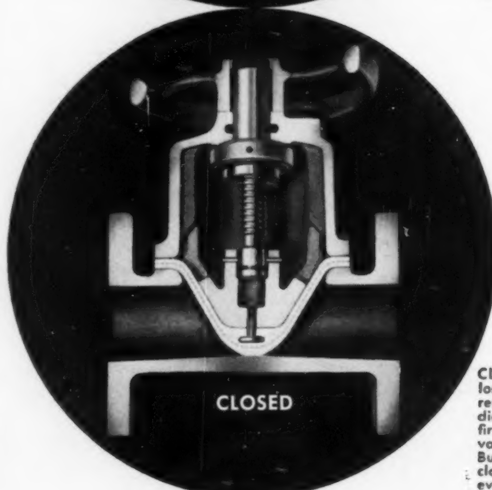


OPEN Diaphragm lifts high for streamline flow. Also, valve design permits comparatively simple rodding through, when necessary.



CLOSED Despite long usage, resilient diaphragm seals firmly against valve body. Bubble-tight closure is assured, even when handling gritty or fibrous materials.

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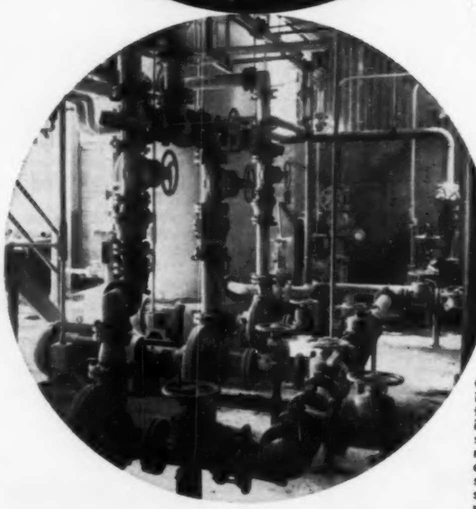

Clogging and interruption to flow is prevented in lines handling a suspension of rubber particles in an acid brine solution at this synthetic rubber plant.

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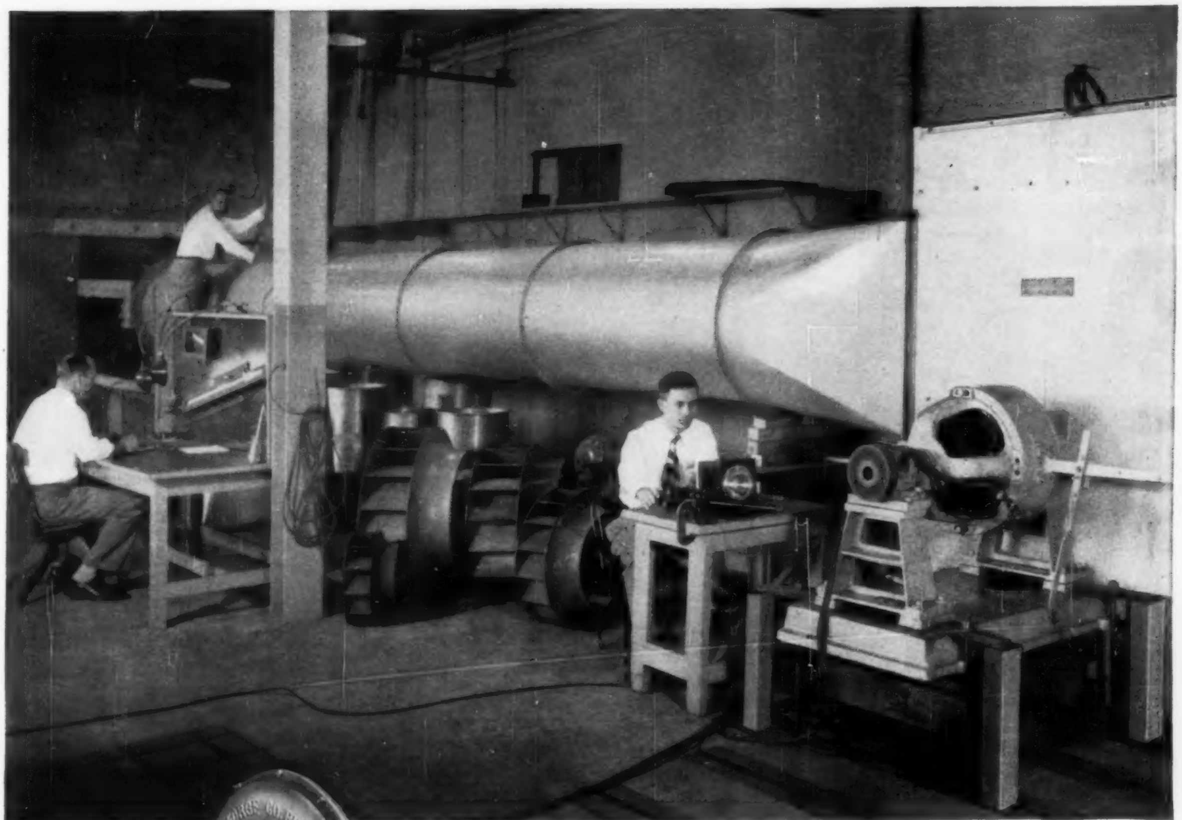

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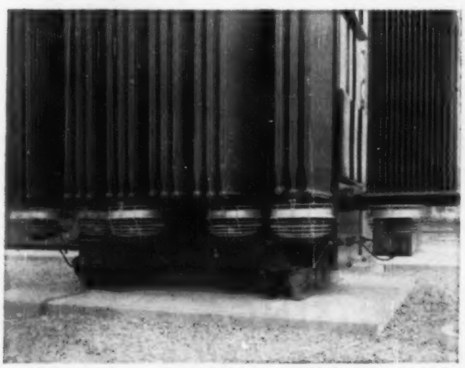

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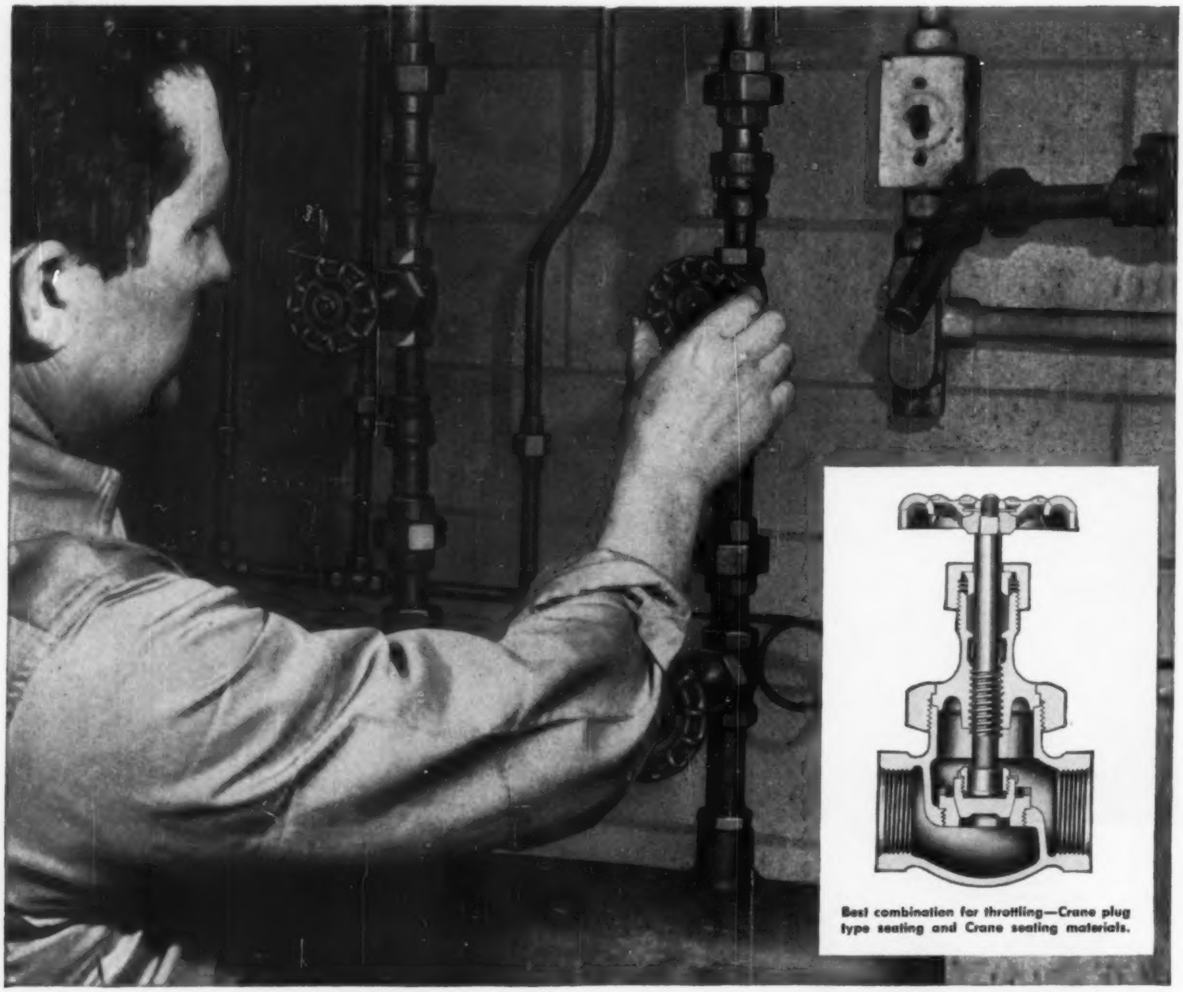

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THE PROCEEDINGS OF THE 1957 CONFERENCE ON LUBRICATION AND WEAR

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It is the complete record of a conference arranged by the Institution of Mechanical Engineers with the cooperation of the ASME for the purpose of evaluating current lubrication knowledge; bringing out the findings of important experiments conducted in the United States, Canada, the United Kingdom, and Europe; and obtaining the views of those participating in the discussions.

Summing up: Besides offering a comprehensive survey of the subject, this volume provides the kind of information that you can use to achieve greater economy in lubricants and maximum reduction in wear.

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Further Experiments on Stepped Thrust-bearings: The Effect of Step Height.
Theory of Rheodynamic Lubrication for a Maxwell Liquid.
Re-examination of the Stepped Thrust-bearing.
Predicting Sleeve-bearing Performance.
Investigation of Cavitation in Lubricating Films Supporting Small Loads.
Dynamically Loaded Journal-bearings of Finite Length.
Experimental Investigation of Temperature Effects in Journal Bearings.
Method of Designing Plain Journal Bearings for Steady Loads.
High Speed Journal Bearings.
Experimental Comparison Between Three Types of Heavy-duty Thrust-bearing.
Temperature Distribution Within Lubricating Films.
Some Characteristics of Conventional Tilting-pad Thrust-bearings.
Visual Study of Film Extent in Dynamically Loaded Complete Journal Bearings.
Experimental Investigation of Friction Loss in High-speed Plain Thrust-bearings.
Observations on the Performance of Air-lubricated Bearings.
On Grease Lubrication of a Slider Bearing.
New Fundamental Testing Methods Applied to Lubricants. Measurement of Mechanical Properties in Continuous Flow.
Film Extent and Whirl in Complete Journal Bearings.
Vibrations in Journal Bearings.
Some Scuffing Experiments in a Disk Machine.
Study of Bearings Under Failure Conditions.
Viscosity-Pressure Dependence of Some Organic Liquids.
The Foil Bearing.
Importance of Surface Finish, Loaded Area Conformity and Operating Temperature in Small-end Plain Bearings for High-duty Two-stroke Engines.
Nature of the Wear Protection of Mild Steel Caused by Phosphating.

BOUNDARY FRICTION

Experimental Check of Elementary Law of Boundary Friction (Dry Friction).
Friction and Wear of Diamond.
Theory of Stick-Slip Sliding of Solids.
The Friction and Wear of Various Materials Sliding Against Unlubricated Surfaces of Different Types and Degrees of Roughness.
Investigation of Size Effects in Sliding by Means of Statistical Techniques.
Probable Behaviour of Contacts in the Sliding Process.
Frictional Behaviour of Anodized Aluminum Surfaces.
Metal Transfer in Boundary Lubrication and the Effect of Sliding Velocity and Surface Roughness.
Calculation of Dry-friction Forces.
On Preliminary Displacement.
Properties of Model Friction Junctions.

BOUNDARY LUBRICATION

Importance of Oil-Metal Adhesion in Lubrication.
Vapour Lubrication and the Friction of Clean Surfaces.
Investigation of Boundary Lubrication in Kinetic Friction by Means of a Wire Tribo-meter.
Orientation and Frictional Behaviour of Lamellar Solids on Metals.
On Friction and Lubrication at Temperatures to 1,000°F. with Particular Reference to Graphite.
On the Influence of Grease Structure on Boundary Lubrication.

BEARING METALS; NOVEL BEARING MATERIALS; GLANDS AND SEALS; SOLID LUBRICANTS; SURFACE TREATMENTS

Compatibility Testing of Bearing Materials.
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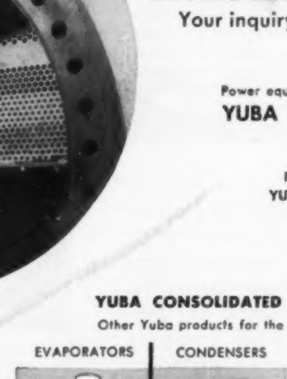

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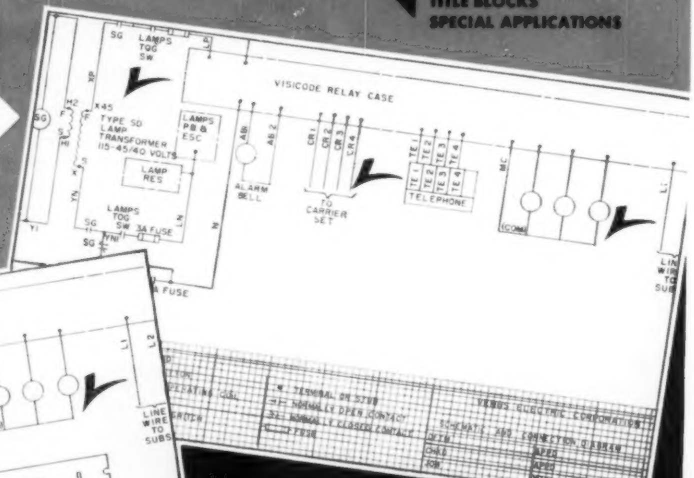

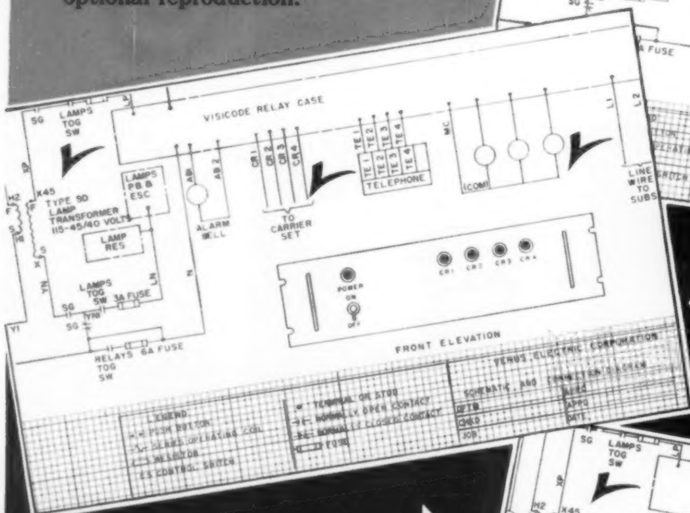

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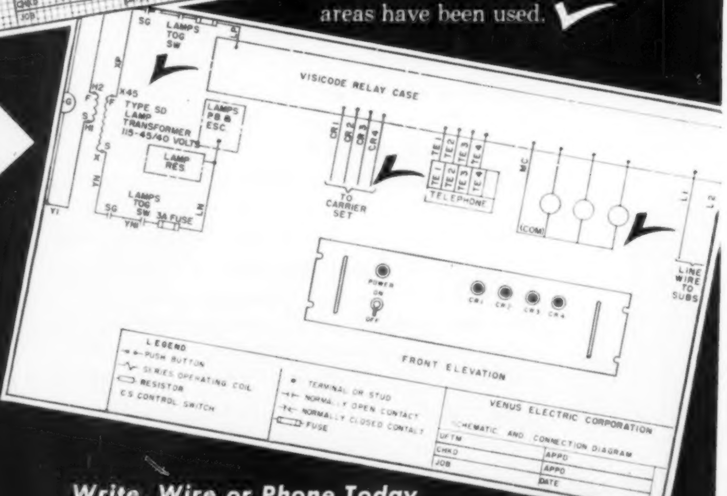

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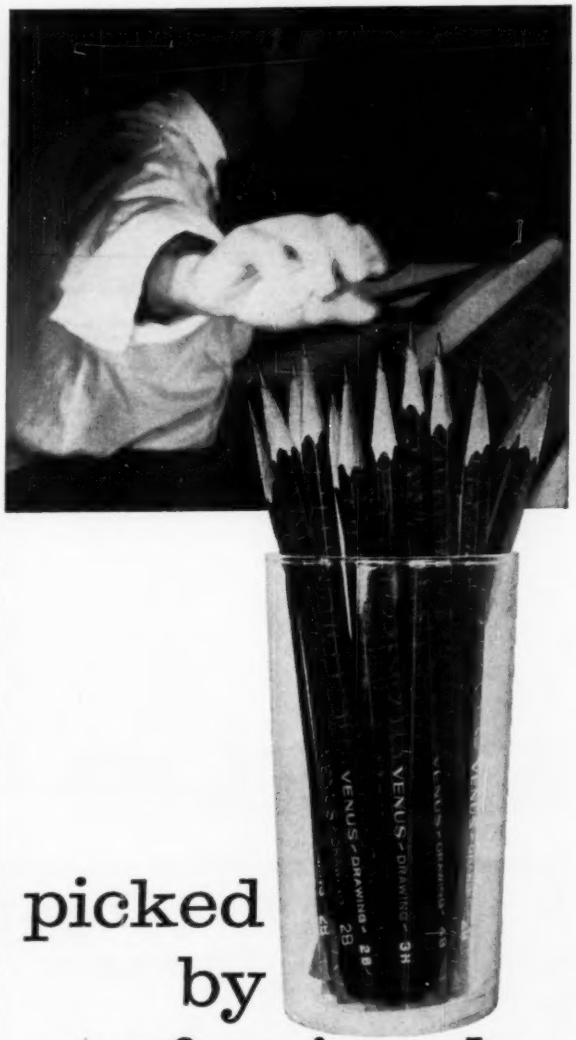

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September, 1958 CARD INDEX Vol. 80, No. 9

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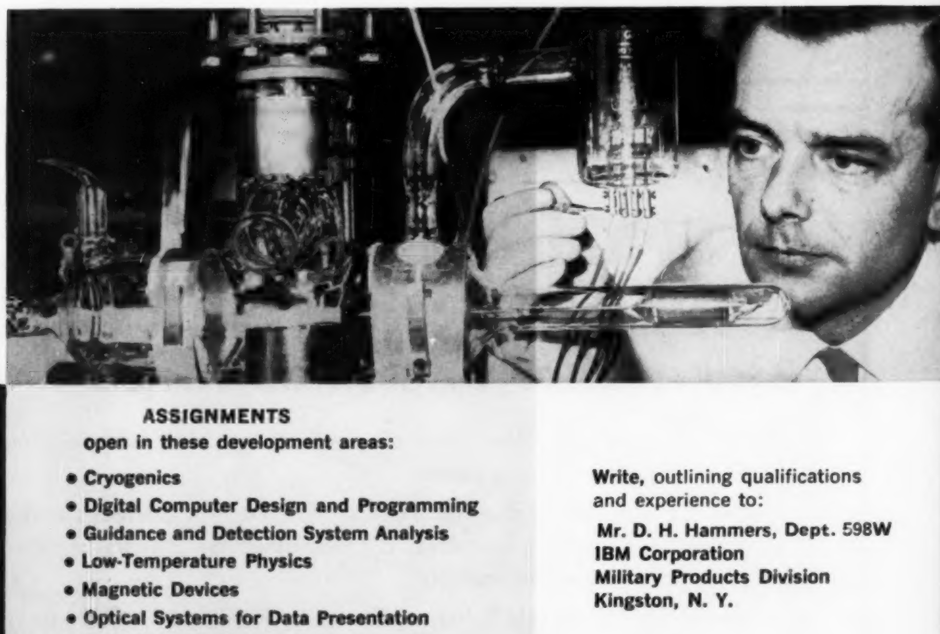

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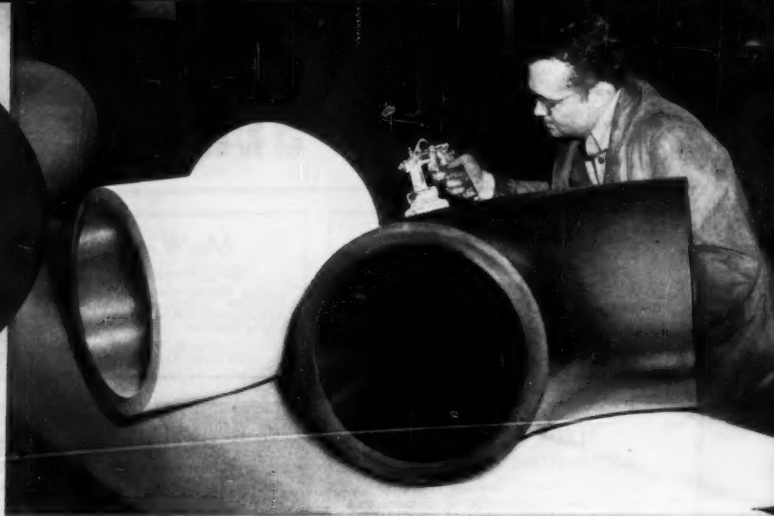

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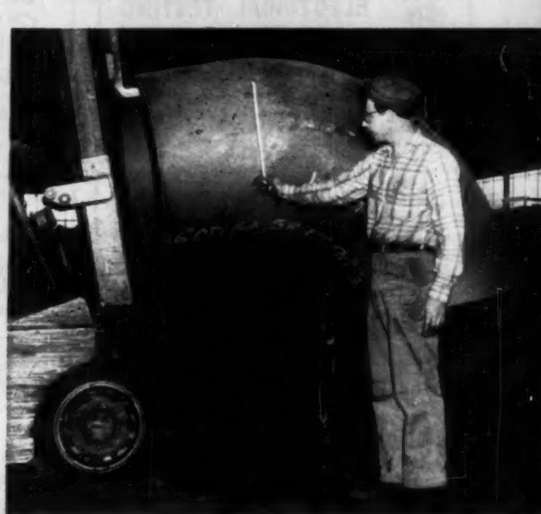

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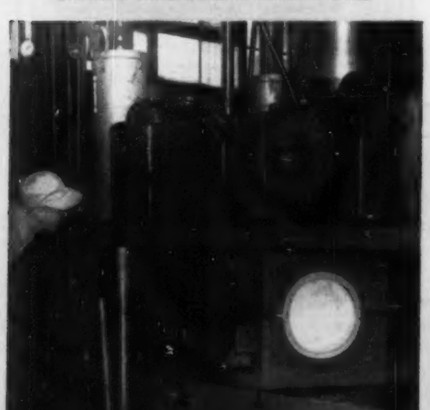

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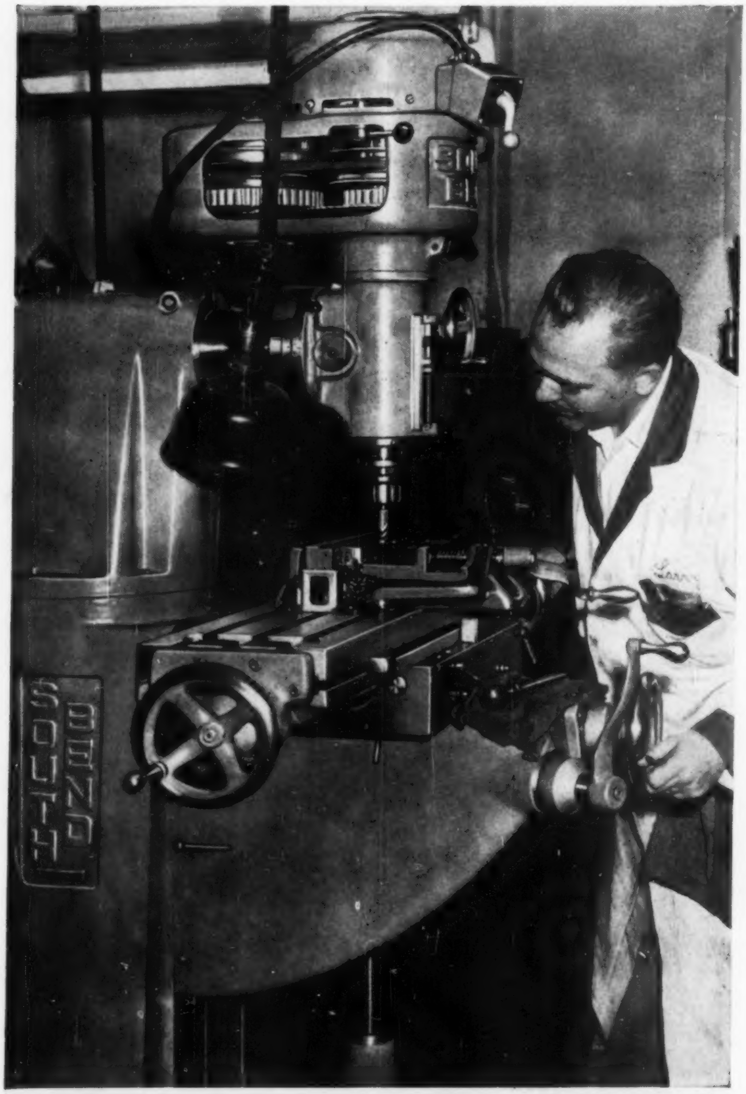

SOUTH BEND LATHE WORKS mounts the adjustable spindle of their vertical precision milling machine on two Timken tapered roller bearings to give it extra accuracy in any position. They also use Timken bearings in the elevating screw mechanism.

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TIMKEN *TAPERED ROLLER BEARINGS ROLL THE LOAD*

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